Attorney's Docket No. 1015290-000795

Reexam

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reissue Application of Degner et al. Application No.: 10/734,073 Filed: December 12, 2003 For: U.S. Patent No. 5,074,456	**Mail Stop INTER PARTES REEXAM** Group Art Unit: 1725 Examiner: J. J. Johnson Confirmation No.: 8903
In re Reexamination Proceeding of Degner et al. Control No.: 90/007,027 Filed: May 4, 2004 For: U.S. Patent No. 5,074,456	
In re Reexamination Proceeding of Degner et al. Control No.: 90/007,114 Filed: July 8, 2004 For: U.S. Patent No. 5,074,456	

RESPONSE TO NOTIFICATION
OF NON-COMPLIANT APPEAL BRIEF (37 CFR 41.37)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is a reply to the Notification of Non-Compliant Appeal Brief (37 CFR 41.37) dated August 28, 2007. The Notification requires correction of section IX. Evidence Appendix and page 107 of the Brief deleting reference to the four U.S. patents listed. Submitted herewith is a "Second Substitute Appeal Brief" (to replace the Appeal Brief filed on January 29, 2007) which includes a revised Section IX, "Evidence Appendix " and edits to the Appeal Brief, as required in the Notice.

A copy of the date-stamped postcard evidencing receipt of the filing fee for the Appeal Brief by the U.S. Patent and Trademark Office is attached.

Should there be any questions regarding this reply, the undersigned can be reached at the number below.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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SECOND SUBSTITUTE APPEAL BRIEF

Mail Stop APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This appeal is from the decision of the Primary Examiner dated September 27, 2006 finally rejecting claims 1-36, which are reproduced as the Claims Appendix of this brief.

Appellant paid the fee of $500.00 for filing the Appeal Brief on January 29, 2007. Accordingly, no further fees are required for this submission.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

I. Real Party in Interest

The present application is assigned to Lam Research Corporation. Lam Research Corporation is the real party in interest, and is the assignee of Patent No. 5,074,456.

II. Related Appeals and Interferences

The Appellants' legal representative, or assignee, does not know of any other appeal or interferences which will affect or be directly affected by or have bearing on the Board's decision in the pending appeal.

III. Status of Claims

Claims 1-36 are pending in this Application and are being appealed.

IV. Status of Amendments

No amendments were filed subsequent to the Final Office Action, dated September 27, 2006.

V. Summary of Claimed Subject Matter

Claim 1

Claim 1 sets forth an improved reactor (**50**, referring to "parallel plate plasma reactors", Abstract, column 1, lines 6-12, 24-48, column 2, lines 8-26, 30-31, 46, 50, column 3, lines 42-51 and 67, column 4, lines 2, 23 and 49, column 5, lines 2-15, column 6, line 17, column 7, lines 13-53, and column 8, line 7, Figures 3-4) of the type having a first electrode (**58**, column 1, lines 44-45, column 3, lines 40-49,

column 7, lines 21-30 and 50-51, Figure 3) for supporting a substrate (column 1, lines 13-14, column 7, lines 22-23), an opposed electrode (**12**, column 1, lines 49-63, Figures 1-4), and means (**70, 72, 78**, column 1, lines 29-32, column 7, lines 38-53, Figure 3) for producing a plasma therebetween, wherein the opposed electrode has one face (column 3, lines 65-66) exposed to the first electrode and an opposite face (**22**, column 4, lines 66-68, column 5, lines 50-52, column 7, lines 59-60, column 8, line 1, Figures 1, 2A, 2B, 2C and 4) connected to an electrical source (**78**, column 3, lines 12-15, column 7, lines 48-51, Figure 3) and a thermal sink (**80**, column 3, line 14, column 5, line 5, column 8, lines 10-27, Figure 4), the improvement comprising an opposed electrode (**12**) including (a) an electrode plate (**12**) composed of a substantially pure material and having a substantially uniform thickness and (b) a support frame (**14**, column 4, lines 66-68, column 5, lines 1-35, 39, 49 and 64, column 6, lines 4, 8, 23, 44, 63 and 67, column 7, lines 4, 8, 12, 58-66, and 68, column 8, lines 2, 10-17, 26-27 and 43, Figures 1, 2A, 2B, 2C, 3 and 4) composed of an electrically and thermally conductive material bonded to a back face of the plate (**12**), whereby the support frame (**14**) is connected to the electrical source (**78**) and thermal sink (**80**) and a front face of the plate (**12**) which is exposed to the first electrode (**58**) is substantially free from protuberances (column 2, lines 36-37, column 4, lines 40-49, column 8, lines 5-8, Figures 1, 2A, 2B, 2C, 3 and 4).

The recitation "a first electrode for supporting a substrate" is not intended to invoke means-plus-function under 35 USC §112, sixth paragraph. The recitation "means for producing a plasma" is intended to invoke means-plus-function under 35 USC §112, sixth paragraph, and the structure described in the specification and drawings corresponding to the claimed unction has been identified as elements 70,

72, 78 in Figure 3 and a description of such structure can be found in column 1, lines 29-32 and column 7, lines 38-53.

Claim 2

Claim 2 sets forth an improved reactor as in claim 1, wherein the opposed electrode (**12**) is mounted in an assembly having an insulating ring (**92**, column 8, lines 47, Figure 4) which is flush (Figure 4) with the entire periphery of the exposed face (**12**), whereby the support frame (**14**) is protected from exposure to the plasma.

Claim 3

Claim 3 sets forth an improved reactor as in claim 1, wherein the electrode plate (**12**) comprises a disk (column 3, lines 52-56, column 4, lines 35-40).

Claim 4

Claim 4 sets forth an improved reactor as in claim 3, wherein the disk includes a plurality of apertures (**16**, column 4, lines 45-54, column 5, lines 30-35, 42-48, column 7, lines 60-63, column 8, line 4, Figures 1, 2B, 2C, 4) therethrough to permit the flow of a reactant gas into the space (Figure 4) between the electrodes (**12**, **58**, Figure 4).

Claim 5

Claim 5 sets forth an improved reactor as in claim 3, wherein the support frame (**14**) comprises a ring (**14**, also called "annular ring", column 4, line 44, column 5, lines 39-40, 49-52 and 64-67, column 6, lines 4, 23, 44, 63 and 67, column 7, lines 4-12 and 68, column 8, lines 2, 10-27 and 43) which is secured about the periphery of the disk (**12**).

Claim 6

Claim 6 sets forth an improved reactor as in claim 3, wherein the support frame (**12**) comprises a plurality of concentric rings (**14a**, **14b**, **14c**, column 7, lines 67-68, column 8, lines 1-4, Figure 2C) secured to the opposite face (**22"**, Figure 2C) of the electrode disk (**12"**).

Claim 7

Claim 7 sets forth an improved reactor as in claim 3, wherein the support frame (**14**) comprises a flat plate (**15**, column 7, lines 54-66, Figure 2B) which is secured to and covers substantially the entire opposite face (**22'**) of the electrode disk (**12'**).

Claim 8

Claim 8 sets forth an improved parallel electrode reactor as in claim 5, wherein the disk (**12**) [h]as a diameter in the range from about 12 to 32 cm and a thickness in the range from about 0.1 to 2 cm (column 4, lines 21-34, D2 and t1 in Table 2).

Claim 9

Claim 9 sets forth an improved reactor as in claim 8, wherein the ring (**4**) has an annular width in the range from about 0.5 to 5 cm and a thickness in the range from about 0.2 to 3 cm (Table 2, column 6, lines 44-52).

Claim 10

Claim 10 sets forth an improved reactor as in claim 1, wherein the plate (**12**) is bonded to the support frame by means of a bonding layer (column 6, lines 1-43 and 54-61, column 7, lines 2-6). The recitation "by means of" is not intended to invoke means-plus-function under 35 USC §112, sixth paragraph.

Claim 11

Claim 11 sets forth an improved reactor as in claim 10, wherein the bonding layer is composed of a material having a low vapor pressure (column 6, lines 6-17).

Claim 12

Claim 12 sets forth an improved reactor as in claim 11, wherein the bonding layer material is selected from the group consisting of indium, silver, and metal-filled epoxies (column 6, lines 6-10 and 36-43).

Claim 13

Claim 13 sets forth an improved reactor as in claim 12, wherein the bonding layer is formed by brazing, soldering, or adhesion (column 5, lines 64-68).

Claim 14

Claim 14 sets forth an improved reactor as in claim 13, wherein at least one of the plate (**12**) and the support frame (**14**) is metallized in the region to be bonded prior to brazing, soldering, or adhesion (column 6, lines 54-61).

Claim 15

Claim 15 sets forth an improved reactor as in claim 10, wherein the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding (column 2, lines 41-47).

Claim 16

Claim 16 sets forth an improved reactor as in claim 1, wherein the electrode plate (**12**) is composed of a pure material selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina, zirconium, diamond-coated materials, and titanium oxides (column 2, lines 29-33, column 3, lines 52-64, column 4, lines 1-7, Table 1).

Claim 17

Claim 17 sets forth an improved reactor as in claim 1, wherein the electrically and thermally conductive material is selected from the group consisting of graphite, aluminum, copper, and stainless steel (column 5, lines 1-17).

Claim 18

Claim 18 sets forth an electrode assembly (**10**, column 3, lines 40-64, column 2, line 66, column 5, lines 13, 23, 36 and 53, column 6, line 62, column 7, lines 6-7, 14-15, 23, 40-41, 50, 54-57 and 67, column 8, lines 5-6 and 42-46) comprising an electrode disk (**12**, also called "electrode plate", column 3, lines 52-64, column 4, lines 35-54, 55-58, column 5, lines 23-24 38-48, 51-52, 64-65, column 6, lines 3-5, 22, 44 and 65-66, column 7, lines 29, 60-62 and 65-66, column 8, lines 1-4, 7-9, 24, 27-34 and 45) composed of a substantially pure material and having a substantially uniform thickness; and a support ring (**14**, also called "annular ring", column 4, line 44, column 5, lines 39-40, 49-52 and 64-67, column 6, lines 4, 23, 44, 63 and 67, column 7, lines 4-12 and 68, column 8, lines 2, 10-27 and 43) bonded about the periphery of one face of the disk, leaving the other face substantially flat and free from protuberances (column 2, lines 36-37, column 4, lines 40-49, column 8, lines 5-8, Figures 1, 2A, 2B, 2C, 3 and 4), wherein the support ring is composed of an electrically and thermally conductive material (column 2, lines 29-33, column 3, lines 52-64, column 4, lines 1-7, Table 1).

Claim 19

Claim 19 sets forth an electrode assembly as in claim 18, wherein the disk (**12**) includes a plurality of apertures (**16**, **16'**, column 4, lines 45-54, column 5, lines

33-35, 42-48, column 7, lines 60-63, column 8, line 4, Figure 1, 2B, 2C, 4) to permit gas flow therethrough.

Claim 20

Claim 20 sets forth an electrode assembly as in claim 18, further comprising at least one additional support ring (**14b**, **14c**, column 7, lines 67-68, column 8, lines 1-4, Figure 2C) mounted concentrically within the peripheral support ring (**14a**) or the one face (**22"**) of the disk (**12**).

Claim 21

Claim 21 sets forth an electrode assembly as in claim 18, wherein the support ring (**14**) includes an interior plate (**15**, column 7, lines 54-66, Figure 2B) which contacts substantially the entire one face (**22'**) of the disk.

Claim 22

Claim 22 sets forth an electrode assembly as in claim 18, wherein the disk (**12**) has a diameter in the range from about 12 to 32 cm and a thickness in the range from about 0.1 to 2 cm (column 4, lines 21-34, D2 and t1 in Table 2).

Claim 23

Claim 23 sets forth an electrode assembly as in claim 18, wherein the ring (**14**) has an annular width in the range from about 0.5 to 5 cm and a thickness in the range from about 0.2 to 3 cm (Table 2, column 6, lines 44-52).

Claim 24

Claim 24 sets forth an electrode assembly as in claim 18, wherein the disk (**12**) is bonded to the ring (**14**) by means of a bonding layer (column 6, lines 1-43 and 54-61, column 7, lines 2-6). The recitation "by means of" is not intended to invoke means-plus-function under 35 USC §112, sixth paragraph.

Claim 25

Claim 25 sets forth an electrode assembly as in claim 24, wherein the bonding layer is composed of a ductile metal or alloy or a metal-filled epoxy having a low vapor pressure (column 6, lines 6-10 and 36-43).

Claim 26

Claim 26 sets forth an electrode assembly as in claim 25, wherein the ductile metal or alloy is selected from the group consisting of indium, silver, and metal-filled epoxies (column 6, lines 6-10 and 36-43).

Claim 27

Claim 27 sets forth an electrode assembly as in claim 26, wherein the bonding layer is formed by brazing, soldering, or adhesion (column 2, lines 37-47, column 5, lines 67-68, column 6, lines 1-43).

Claim 28

Claim 28 sets forth an electrode assembly as in claim 27, wherein at least one of the disk (**12**) and the ring (**14**) is metallized in the region to be bonded prior to brazing, soldering, or adhesion (column 6, lines 54-61).

Claim 29

Claim 29 sets forth an electrode assembly as in claim 24, wherein the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding (column 2, lines 41-47).

Claim 30

Claim 30 sets forth an electrode assembly as in claim 18, wherein the material is selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina,

zirconium, diamond-coated materials, and titanium oxides (column 2, lines 29-33, column 3, lines 52-64, column 4, lines 1-7, Table 1).

Claim 31

Claim 31 sets forth an electrode assembly as in claim 18, wherein the electrically and thermally conductive material is selected from the group consisting of graphite, aluminum, copper, and stainless steel (column 5, lines 1-17).

Claim 32

Claim 32 sets forth an electrode assembly as in claim 18, wherein the support ring (**14**) is pre-stressed to impart a radially inward compression (column 3, lines 1-12, column 6, lines 62-68, column 7, lines 1-12) on the electrode disk (**12**).

Claim 33

Claim 33 sets forth a method for forming an electrode assembly (**10**, column 3, lines 40-64, column 2, line 66, column 5, lines 13, 23, 36 and 53, column 6, line 62, column 7, lines 6-7, 14-15, 23, 40-41, 50, 54-57 and 67, column 8, lines 5-6 and 42-46) including a support ring (**14**, also called "annular ring", column 4, line 44, column 5, lines 39-40, 49-52 and 64-67, column 6, lines 4, 23, 44, 63 and 67, column 7, lines 4-12 and 68, column 8, lines 2, 10-27 and 43) and an electrode plate (**12**, column 3, lines 52-64, column 4, lines 35-54, 55-58, column 5, lines 23-24 38-48, 51-52, 64-65, column 6, lines 3-5, 22, 44 and 65-66, column 7, lines 29, 60-62 and 65-66, column 8, lines 1-4, 7-9, 24, 27-34 and 45), said method comprising: bonding the support ring (**14**) about the periphery of the electrode plate (**12**) at elevated temperature, wherein the material of the support ring (**14**) has a higher coefficient of thermal expansion than that of the electrode plate (**12**), (column 3, lines 1-12, column 6, lines 62-68, column 7, lines 1-12); and allowing the bonded assembly to

return to room temperature, whereby the differential contraction imparts the desired stress (column 3, lines 1-12, column 6, lines 62-68, column 7, lines 1-12).

The recitation "method for forming" is not intended to invoke step-plus-function under 35 USC §112, sixth paragraph.

Claim 34

Claim 34 sets forth a method as in claim 33, wherein the elevated temperature is chosen to be above an expected operating temperature of the electrode assembly (column 3, lines 1-12, column 6, lines 62-68, column 7, lines 1-12).

Claim 35

Claim 35 sets forth a method as in claim 33, wherein the electrode plate is formed from a substantially pure material selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina, zirconium, diamond-coated materials, and titanium oxides (column 2, lines 29-33, column 3, lines 52-64, column 4, lines 1-7, Table 1).

Claim 36

Claim 36 sets forth an electrode assembly (**10**, column 3, lines 40-64, column 2, line 66, column 5, lines 13, 23, 36 and 53, column 6, line 62, column 7, lines 6-7, 14-15, 23, 40-41, 50, 54-57 and 67, column 8, lines 5-6 and 42-46) formed by the method of claim 33.

VI. Grounds of Rejection to be Reviewed on Appeal

1. Claims 1, 3-5, 16-19, 30 and 31

Claims 1, 3-5, 16-19, 30 and 31 stand rejected under 35 U.S.C. §102(b) as allegedly anticipated by JP 01-204424 ("Takao").

2. Claim 2

Claim 2 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of U.S. Patent No. 4,340,462 ("Koch").

3. Claim 6

Claim 6 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of EP 346055 ("Okazaki").

4. Claim 7

Claim 7 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of JP 61-243170 ("Shigeru").

5. Claims 8-9

Claims 8-9 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao.

6. Claims 10-13

Claims 10-13 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of JP 61-279672 ("Yamada").

7. Claims 14-15

Claims 14-15 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and Yamada and further in view of Shigeru.

8. Claim 20

Claim 20 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of EP 346055 ("Okazaki").

9. Claim 21

Claim 21 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of JP 61-243170 ("Shigeru").

10. Claims 22-23

Claims 22-23 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao.

11. Claims 24-27

Claims 24-27 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of JP 61-279672 ("Yamada").

12. Claims 28-29

Claims 28-29 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and Yamada and further in view of Shigeru.

13. Claim 32

Claim 32 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of JP 61-243170 ("Shigeru").

14. Claims 33-36

Claims 33-36 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Shigeru and Yamada.

VII. Argument

A. Legal Standards

1. "Plain Meaning" of Words in a Claim

As stated in MPEP § 2111.01 (II), the "plain meaning" of words in a claim refers to the ordinary and customary meaning given to the words by those of ordinary skill in the art. As articulated by the Federal Circuit, "the ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, *i.e.*, as of the effective filing date of the patent application." *Phillips v. AWH Corp.*, 415 F.3d 1303,

1312, 75 USPQ2d 1321, 1326 (Fed. Cir. 2005) (*en banc*). It is the use of the words in the context of the written description and customarily by those skilled in the relevant art that accurately reflects both the "ordinary" and the "customary" meaning of the terms in the claims. *Ferguson Beauregard/Logic Controls v. Mega Systems*, 350 F.3d 1327, 1338, 69 USPQ2d 1001, 1009 (Fed. Cir. 2003). Furthermore, "[i]n the absence of an express intent to impart a novel meaning to the claim terms, the words are presumed to take on the ordinary and customary meanings attributed to them by those of ordinary skill in the art." *Brookhill-Wilk 1, LLC v. Intuitive Surgical, Inc.*, 334 F.3d 1294, 1298, 67 USPQ2d 1132, 1136 (Fed. Cir. 2003).

2. Anticipation

It is well established that a claim is anticipated only if "each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987). See also MPEP §2131. However, the fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993). That is, inherency may not be established by probabilities or possibilities. *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999). See also MPEP §2112 wherein it is stated that the Examiner must provide a basis in fact and/or technical reasoning to reasonably support a determination that allegedly inherent characteristics flows from the teachings of the applied prior art.

3. Obviousness

As set forth in *Dickinson v. Zurko*, 527 US 150, 50 USPQ2d 1930 (1999), tribunals of the USPTO are governed by the Administrative Procedure Act and BPAI

decisions must be set aside if unsupported by substantial evidence. Accordingly, rejections under 35 U.S.C. §103 must be based on "evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness" *In re Lee*, 277 F.3d 1338, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002). A showing of a suggestion, teaching , or motivation to combine the prior art references is an essential component of an obviousness holding and "particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed." (Emphasis Added). *Id.* Conclusory statements regarding what is "basic knowledge" and "common sense" cannot be used to cure deficiencies of the cited references.

To avoid an impermissible hindsight reconstruction of the prior art, it is necessary "to consider the thinking of one of ordinary skill in the art at the time of the invention and guided only by the prior art references and then-accepted wisdom in the field" (Emphasis Added). *In re Kotzab*, 217 F.3d 1365, 1369, 55 USPQ2d 1313, 1316 (Fed. Cir. 2000). The motivation, suggestion or teaching to modify the primary reference "may come explicitly from statements in the prior art, the knowledge of one of ordinary skill in the art, or, in some cases the nature of the problem to be solved." *Kotzab*, 217 F.3d 1370, 55 USPQ2d at 1317. However, while the teaching, motivation or suggestion may be implicit from the prior art as a whole, rather than expressly stated in the references, the test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art. *Id.* To rely on an express or implicit showing, particular findings related

thereto must be provided. *Id.* Conclusory statements are not evidence. In *Kotzab*, the court reversed the USPTO decision because "there was no finding as to the specific understanding or principle within the knowledge of a skilled artisan that would have motivated one with no knowledge of Kotzab's invention to make the combination in the manner claimed." *Kotzab*, 217 F.3d 1370, 55 USPQ2d at 1318.

An obviousness determination under 35 U.S.C. § 103 requires consideration of the claimed invention "as a whole." *Ruiz v. A.B. Chance Co.*, 357 F.3d 1270, 69 USPQ2d 1686, 1690 (Fed. Cir. 2004). As set forth in this case:

> The 'as a whole' instruction in title 35 prevents evaluation of the invention part by part. Without this important requirement, an obviousness assessment might break an invention into its component parts (A + B + C), then find a prior art reference containing A, another containing B, and another containing C, and on that basis alone declare the invention obvious. This form of hindsight reasoning, using the invention as a roadmap to find its prior art components, would discount the value of combining various existing features or principles in a new way to achieve a new result - often the very definition of invention. *Id.*

The discovery of a source of a problem is part of the "subject matter as a whole" inquiry of 35 U.S.C. § 103. *In re Sponnoble*, 405 F.2d 578, 160 USPQ 237, 243 (CCPA 1969); MPEP § 2141.02(III). The discovery of the source of a problem can provide the basis of a patentable invention even though the remedy for the problem may be obvious once the source is identified. *Sponnoble*, 405 F.2d 578, 160 USPQ at 243. As set forth in *In re Shaffer*, 229 F.2d 476, 480, 108 USPQ 326, 329 (CCPA 1956):

> In fact, a person having the references before him who was not cognizant of appellant's disclosure would not be informed that the problem faced by appellant ever existed. Therefore, <u>can it be said that these references which never recognized appellant's problem would have suggested its solution? We think not</u>, and therefore feel that the references were improperly combined since there is no suggestion in either of the references

> that they can be combined to produce appellant's result. (Emphasis added).

In *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143, 148-49 (CCPA 1976), the court reversed the USPTO's finding of obviousness because the applied art failed to recognize, and thus did not suggest a solution to, the particular problem encountered by the inventor in scaling up a process disclosed by one of the applied references.

As set forth in *In re Rouffet*, 149 F.3d 1350, 47 USPQ2d 1453, 1457-58 (Fed. Cir 1998):

> To prevent use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the case of obviousness. In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. (Emphasis added).

In *Rouffet*, the court found that the USPTO failed to rely on the nature of the problem to be solved, the teachings of the prior art, or the knowledge of persons of ordinary skill in the art as a source of motivation to combine prior art references applied in a rejection under 35 U.S.C. § 103, and reversed the rejection. *Id.* at 1458.

The mere fact that a reference may be modified does not make the resultant modification obvious unless the art suggested the desirability of the modification. *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1783-84, n. 14 (Fed. Cir. 1992); *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984); *Kotzab*, 217 F.3d 1365, 1369-1370, 55 USPQ2d at 1316-17; MPEP § 2143.01(I).

4. Secondary Evidence of Nonobviousness

a. Proposed Modification Cannot Render the Prior Art Unsatisfactory for Its Intended Purpose

As stated in MPEP § 2143.01(V), if the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

b. Evidence of Superiority of a Property Shared With the Prior Art

As stated in MPEP § 716.02(a)(II), evidence of unobvious or unexpected advantageous properties, such as superiority in a property the claimed compound shares with the prior art, can rebut *prima facie* obviousness:

> Evidence that a compound is unexpectedly superior in one of a spectrum of common properties . . . can be enough to rebut a *prima facie* case of obviousness."

No set number of examples of superiority is required. *In re Chupp*, 816 F.2d 643, 646, 2 USPQ2d 1437, 1439 (Fed. Cir. 1987).

B. Rejection of Claims 1, 3-5, 16-19, 30 and 31 under 35 U.S.C. §102(b) over JP 01-204424 (Takao)

The final Official Action rejects Claims 1, 3-5, 16-19, 30 and 31 as allegedly anticipated by Takao. The Official Action contends that with respect to Claims 1, 3-5, and 16-17:

1. The Rejection

> Takao teaches a reactor of the type having a first electrode for supporting a substrate, an opposed electrode, and means for producing a plasma therebetween, wherein the opposed electrode has one face exposed to the first electrode and an opposite face connected to an electrical source and a thermal sink (figure 1, items 7, 5, 13, 14 and page 2), the improvement comprising an opposed electrode including (a) an electrode plate composed of a substantially pure material (amorphous carbon) and having a substantially uniform thickness (figure 1, item 7) and (b) a support frame composed of an electrically and thermally conductive material (aluminum) bonded to a back face of the

plate, whereby the support frame is connected to the electrical source and thermal sink and a front face of the plate which is exposed to the first electrode is substantially free from protuberances (page 8, and figure 1, items 4 and 7); wherein the electrode plate comprises a disk (figure 1, item 7); wherein the disk includes a plurality of apertures therethrough to permit the flow of a reactant gas into the space between the electrodes (figure 1, item 7, apertures); wherein the support frame comprises a ring which is secured about the periphery of the disk (figure 1, item 7, ring); wherein the electrode plate is composed of a pure material selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumnina, zirconium, diamond-coated materials, and titanium oxides (page 2); wherein the electrically and thermally conductive material is selected from the group consisting of graphite, aluminum, copper, and stainless steel (page 4). (Final Rejection at pages 2-3.)

2. Claimed Subject Matter

Claim 1 is written in Jepson format and sets forth a reactor of the type having a first electrode for supporting a substrate, an opposed electrode, and means for producing a plasma therebetween, wherein the opposed electrode has one face exposed to the first electrode and an opposite face connected to an electrical source and a thermal sink, the improvement comprising an opposed electrode including (a) an electrode plate composed of a substantially pure material and having a substantially uniform thickness and (b) a support frame composed of an electrically conductive material bonded to a back face of the plate, the support frame connected to the electrical source and thermal sink and a front face of the plate is substantially free from protuberances (emphasis added). The combination of features recited in Claim 1 is not disclosed by Takao.

3. Claim Features Missing in Takao

In the Official Action, it is alleged that Takao discloses "a reactor of the type having ...an opposed electrode ... wherein the opposed electrode has one face

exposed to the first electrode and an opposite face connected to an electrical source and a thermal sink (figure 1, items 7, 5, 13, 14 and page 2)" wherein the opposed electrode is an amorphous carbon electrode 7 "bonded" to a back face of aluminum frame 4. (Final Office Action at page 2, ¶ 2). Assuming that the Examiner is considering Takao's electrode 4 as the claimed support frame and the electrode 7 as the claimed opposed electrode, the Official Action does not identify the structure of Takao corresponding to the claimed thermal sink.

The Official Action also does not identify any teaching in Takao that electrode 7 is "bonded" to frame 4 nor does the Official Action address the fact that the sealed ring 12 of Takao protrudes from the exposed surface of Takao's electrode 7. In Takao's drawings, "sealed ring" 12 overlies (and thus protrudes from) the exposed surface of electrode 7 which is clamped between sealed ring 12 and electrode body 4.

If Takao's electrode 4 is considered the claimed support frame, there is no structure in Takao corresponding to the claimed thermal sink and if Takao's electrode 4 is considered the claimed thermal sink there is no structure in Takao corresponding to the claimed support frame. Moreover, opposed surfaces of Takao's electrode 7 and electrode 4 are unbonded and the front face of Takao's electrode 7 is not substantially free from protuberances due to the presence of ring 12 overlying the electrode 7. Accordingly, Takao clearly fails to anticipate the subject matter of Claim 1.

4. Bonded Does Not Mean Clamping Together Unbonded Surfaces By Mechanical Structure

In the "Response to Arguments" section of the final Official Action, the Examiner takes the following position:

> Applicant argues Takao does not teach that the electrode (7) is "bonded" to the frame (4). The examiner disagrees. During patent examination, the pending claims must be "given the broadest reasonable interpretation." Applicant always has the opportunity to amend the claims during prosecution, and broad interpretation by the examiner reduces the possibility that the claim, once issued, will be interpreted more broadly than is justified. *In re Prater*, 415 F.2d 1393, 1404-05, 162 USPQ 541, 550-51 (CCPA 1969). In the instant case, the [sic] interprets "bonded" to mean "something that fastens things together." In applying the *Prater* test by giving the claim its broadest reasonable interpretation, it is the examiner's position that the insulating ring coupled with the sealed ring bonds or fastens the electrode (7) to the frame (4). (Final Official Action at page 10).

The Examiner contends that the claim term "bonded" can be interpreted to mean "something that fastens things together." Such interpretation is improper on the basis that (1) the Examiner's interpretation improperly interprets the term "bonded" without reference to the specification and therefore cannot be "consistent with the specification". See *In re Hyatt*, 211 F.3d 1367, 54 USPQ 1664 (Fed. Cir. 2000) and *Ginter v. Benson*, unpublished, 79 USPQ 1234 (BPAI 2005) and (2) the Examiner's interpretation does not establish how the term "bonded" would be interpreted by "those of ordinary skill in the art." *In re Cortright*, 165 Fx3d 1353, 49 USPQ2d 1464 (Fed. Cir. 1999).

The Examiner has not read the term "bonded" in light of the specification as the term would be interpreted by one of ordinary skill in the art. Instead, the Examiner's interpretation of "bonded" conflicts with the meaning of "bonded" given in the specification.

The Examiner's interpretation of "bonded" is inconsistent with the usage of that term in the '456 patent. While terms such as "attachment" (column 2, line 67), "mounting" (column 5, line 13), "secured" (column 6, line 23) and "attached" (column 8, line 13) could be interpreted to include bonding or mechanically attaching via "bolting" (column 2, line 68) or "fasteners" (column 3, line 1), in the '456 patent the term "bonded" is used in the conventional sense to describe a joint between two surfaces and thus excludes unbonded surfaces clamped together with a mechanical structure. As explained in the '456 patent:

> According to the present invention, an electrode assembly suitable for use in a parallel plate plasma reactor comprises a plate, usually in the form of a disk, composed of a "semiconductor purity" material having a substantially uniform thickness. One face of the plate is **bonded** to a support frame composed of an electrically and thermally conductive material, leaving the other face substantially flat and free from protuberances. Usually, the support frame will be in the form of a ring which is **bonded** about the periphery of a plate in the from of a disk. Preferably, a plate and support frame are **bonded** together with a relatively ductile **bonding layer** formed by brazing, soldering, or the like. The **bonding material** should be composed of a thermally and electrically conductive material, such as metals, conductive epoxies, or the like preferably being formed from low vapor pressure materials which will have less tendency to contaminate low pressure reactor environments. (Column 2, lines 29-47).
>
> The material of the support frame will usually be chosen to have a thermal expansion coefficient which is generally compatible with that of the electrode plate, but a certain amount of mismatch can be tolerated when the **bonding layer** is formed from a ductile material. In a preferred embodiment, the support frame is chosen to have a slightly greater coefficient of thermal expansion. By then joining and/or curing the **bonding layer** at a temperature above the expected operating temperature of the electrode, the electrode plate will be maintained under compression, enhancing the durability of the plate. In this way, the support frame can be reliably connected to an electrical power source as well as a heat sink intended to control the temperature of the electrode. By properly configuring the contact area between the support frame and the electrode plate, the rf fields produced by the electrode as well as the temperature profile

maintained across the electrode can be maintained within desired parameters. (Column 3, lines 1-19).

The support ring 14 may be **bonded** to the electrode plate 12 by any suitable process which provides the necessary **bonding** strength as well as thermal and electrical characteristics. Typically, **bonding** will be performed by either brazing, soldering or use of adhesives to form a ductile **bonding layer**, preferably having a low vapor pressure. The ductility is desirable so that any thermal expansion mismatch between the electrode plate 12 and support ring 14 will not result in breaking or fracturing of the **bond**, or the electrode plate 12. (Paragraph bridging columns 5 and 6).

With both soldering and brazing, a metallic **bonding layer** will be formed between the electrode plate and the support frame. Suitable metals include ductile, low vapor pressure metals, such as indium, silver, and alloys thereof. Particularly preferred is the use of indium. The characteristics of indium are particularly well balanced for use as the **bonding layer**. Indium is available at relatively high purity, has a high ductility, and provides good wetting of and adhesion to other metals. Additionally, indium has moderate strength, a moderate melting point, and a relatively low vapor pressure which minimizes loss into the reactor. The difference between soldering and brazing is primarily temperature, with soldering generally being performed at below about 800° F and brazing generally being performed at above about 800° F. (Column 6, lines 6-21).

In a preferred embodiment, the electrode plate 12 is secured to the support ring 14 by soldering with indium at a temperature of about 310° F to 320° F. Soldering is a less expensive process and is particularly suitable for joining materials which have a large mismatch in their coefficients of thermal expansion. The relatively low solidification temperature of soldered materials minimizes the expansion mismatch at the solidification temperature. Brazing will usually provide a higher strength **bond**, but is suitable only for materials which have well matched thermal expansion coefficients in order to avoid high stresses in the **bonding layer** and electrode plate after cooling to room temperature. (Column 6, lines 22-35).

As an alternative to soldering or brazing, the **bonding layer** may be formed from an electrically and thermally conductive adhesive, preferably from a metal filled epoxy such as a silver, aluminum, nickel, platinum, gold, iron, and copper-filled epoxy. Suitable metal filled epoxies are commercially available from suppliers, such as Devcon Corporation, Thermoset Plastics, Shell Company, and Varian Associates. (Column 6, lines 36-43).

> In forming the electrode assembly 10, it will be desirable to "pre-stress" the support ring 14 so that it provides a radially-directed inward compression on the electrode plate 12. Such a compressive stress helps to inhibit stress fracturing of the electrode plate 12 during use. More specifically, by utilizing a support ring 14 which is formed from a material which has a slightly larger thermal expansion coefficient than that of the electrode plate, and forming or curing the **bonding layer** at a temperature above the expected operating temperature, the support ring will apply a constant compressive force on both the electrode plate and the **bonding layer**. Even when the temperature of the electrode assembly is raised form room temperature to the operation temperature, the support ring will still be in compression (although reduced relative to room temperature). Thus, thermal cycling will be less likely to fracture the electrode plate which is fragile relative to the support ring. (Paragraph bridging columns 6 and 7).

From the foregoing, it is clear that the '456 patent uses the term "bonding" or "bonded" to refer to a joint or "bond" between opposing surfaces rather than unbonded surfaces clamped together by a mechanical structure (see column 8, lines 7-10).

The Examiner does not contend that the term "bonded" is not defined in the specification. (Cf. *In re Hauserman Inc.*, (unpublished) 15 USPQ 1157 (Fed. Cir. 1989) "simply because a term is not defined in the specification does not mean any conceivable definition or interpretation of the term can be used"). Instead, the Examiner has chosen to ignore the specification and chose "any conceivable definition or interpretation", an approach which is contrary to well established legal precedent.

The '456 patent describes several types of "bonded" arrangements such as soldering, brazing, and *adhesive joints*. Given its broadest reasonable interpretation, "bonded" could encompass bonding methods besides those explicitly disclosed in

the '456 patent (see, for example, *Ex parte Holcomb et al*, Appeal No. 2004-D140 (BPAI 2004) wherein on page 10 of the decision shrink fit bonding and diffusion bonding are described as creating a bond which can sustain substantial shear stress or create a strong chemical bond). In the present case, the Examiner is interpreting "bonded" to cover surfaces which are unbonded but clamped together by a mechanical structure. The Examiner's interpretation of "bonded" is thus unreasonable and renders the rejection of Claim 1 over Takao untenable.

Takao does not disclose or suggest an electrode plate bonded to a support frame such that the front face exposed to the opposed electrode is substantially free from protuberances. In fact just the opposite is taught in Takao as Takao requires the sealed ring 12 to make the plasma the same size as the wafer 13 to be etched (see translation of Takao at page 4, lines 20-22). While the term "protuberances" is not given a special meaning in the '456 patent specification, the customary dictionary meaning of "protuberance" is "something that protrudes." As shown in Takao's Figure 1, sealed ring 12 clearly overlies and thus "protrudes" from the exposed face of the electrode 7. As such, Takao fails to anticipate the subject matter of Claim 1.

Claim 1 is patentable over Takao since Takao fails to disclose any structure corresponding to the claimed thermal sink and support frame as Takao's electrode 4 can only correspond to one of these claimed features. Claim 1 is also patentable over Takao since there is no bond between opposed surfaces of the electrodes 4, 7 and ring 12 forms a protrusion extending from the front face of electrode 7. As such, Takao fails to meet the claimed features of (1) a support frame connected to a thermal sink, (2) a bond between opposed surfaces of an electrode and the support frame, and (3) a front face of the electrode substantially free from protuberances.

5. Claims 3-5, 16 and17

Claims 3-5 and 16-17 depend from Claim 1 and are patentable for at least the reasons that Claim 1 is patentable over Takao. In addition, Takao fails to disclose a support frame comprising a ring as set forth in Claim 5. As explained above, Takao fails to disclose a support frame connected to a thermal sink and therefore fails to disclose a support frame in the form of a ring connected to a thermal sink.

As shown in Figure 4 of the '456 patent, support ring 14 is bonded on one face to electrode disk 12 and the support ring is connected to a thermal sink comprising water cooled backing plate 80 (see column 8, lines 5-26 of '456 patent). In Takao, the aluminum electrode 4 is water cooled and to the extent water cooled electrode 4 is considered a thermal sink, there is no support frame (Claim 1) or support ring (Claim 5) between the water cooled thermal sink 4 and the amorphous carbon electrode 7. If Takao's water cooled electrode 4 is considered the claimed support frame, there is no structure in Takao corresponding to the claimed thermal sink (Claim 1) or the claimed support ring (Claim 5).

Claim 17 recites that the support frame is of graphite, aluminum, copper or stainless steel whereas if Takao's water cooled electrode is considered the claimed thermal sink, Takao fails to disclose a support frame connected to such thermal sink and thus cannot disclose the claimed support frame materials set forth in Claim 17.

6. Claim 18

Claim 18 sets forth an electrode assembly comprising an electrode disk composed of a substantially pure material and having a substantially uniform

thickness and a support ring bonded about the periphery of one face of the disk, leaving the other face substantially flat and free from protuberances, wherein the support ring is composed of an electrically and thermally conductive material.

7. The Rejection

With respect to Claims 18, 19, 30, and 31, the Official Action also contends that:

> Takao teaches an electrode composed of a substantially pure material (amorphous carbon) and having a substantially uniform thickness (figure 1, item 7); and a support ring bonded about the periphery of one face of the disk (where the electrode body 4 is bonded around the periphery of electrode 7), leaving the other face substantially flat and free from protuberances, wherein the support ring is composed of an electrically and thermally conductive material (where the electrode body 4 is made of aluminum); wherein the disk includes a plurality of apertures to permit gas flow therethrough (figure 1, item 7, apertures); wherein the electrode plate is composed of a pure material selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina, zirconium, diamond-coated materials, and titanium oxides (page 2); wherein the electrically and thermally conductive material is selected from the group consisting of graphite, aluminum, copper, and stainless steel (page 4). (Final Rejection at page 4.)

8. Missing Claim Features

As explained above in connection with Claim 1, Takao's water cooled electrode 4 cannot be considered both the claimed support frame and the claimed thermal sink. As explained above in connection with Claim 5, even if Takao's water cooled electrode is considered the claimed support frame, there is no disclosure in Takao of a support ring. Accordingly, Takao fails to disclose (1) the claimed support ring and (2) a bond between Takao's electrode 7 and a support ring. Moreover, as explained above in connection with Claim 1, because Takao requires the insulating

ring 12 to control the size of the plasma, even if Takao's electrode 7 was bonded to water cooled electrode 4, the exposed surface of Takao's electrode 7 would not be substantially free from protuberances. Thus, the combination of features recited in Claim 18 is patentable over Takao.

9. Claims 19, 30 and 31

Claims 19 and 30-31 depend from Claim 18 and are patentable for at least the reasons that Claim 18 is patentable over Takao. Claim 31 recites that the support ring is of graphite, aluminum, copper or stainless steel whereas Takao fails to disclose a support ring and thus cannot disclose the claimed support frame materials.

C. Rejection of Claim 2 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) in view of U.S. Patent No. 4,340,462 (Koch)

Claim 2 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Koch. The Official Action contends that:

1. The Rejection

> Koch teaches the opposed electrode is mounted in an assembly having an insulating ring which is flush with the entire periphery of the exposed face, whereby the support frame is protected from exposure to the plasma (figure 3, item 20, 22). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the structure of the electrode in order to provide a sealable chamber (Koch, col. 3, ll. 60-67). (Final Rejection at page 4, ¶ 2)

2. Claimed Subject Matter

Claim 2 depends from Claim 1 and recites that the opposed electrode is mounted in an assembly having an insulating ring which is flush with the entire

periphery of the exposed face, whereby the support frame is protected from exposure to the plasma.

The term "flush" is used only in Claim 2 of the '456 patent and does not appear in Koch. The common dictionary meaning of "flush" is "having surfaces in the same plane," or "arranged with adjacent sides, surfaces, or edges close together." The '456 patent describes insulating rings 90 and 92 as "provided about the outer periphery of the electrode assembly 10" and that "[s]uch structure protects the support ring 12 from direct contact with the plasma, enhances the electrical field properties of the electrode plate 12 during use, and electrically insulates the electrode assembly 10 from the upper structure" ('456 patent at column 8, lines 40-47). As shown in Figure 4 of the '456 patent, ring 90 surrounds part of the electrode plate 12 and ring 92 overlies ring 90 and surrounds the remainder of plate 12.

If the insulating ring recited in Claim 2 covers ring 90, "flush" means sides, surfaces or edges close together. If the ring recited in Claim 2 only covers ring 90, "flush" means sides, surfaces or edges close together and surfaces in the same plane. If "flush" is given its broadest reasonable interpretation in order to cover ring 90 and ring 92, "flush" is not limited to one of its meanings, i.e., having surfaces in the same plane. In such case, Takao already shows an insulating ring 11 with sides, surfaces or edges close together to those of electrode 7 and there would be no reason to replace Takao's ring 11 with insulating ring 20 of Koch as Takao already meets the claimed insulating ring limitation.

2. <u>Claim Features Missing In Combined References</u>

In the Official Action, Koch is cited for disclosure of an insulating ring flush with the entire periphery of the exposed face such that the support frame is protected

from exposure of the plasma and it is alleged that it would have been obvious to modify Takao to utilize the structure of Koch "to provide a sealable chamber" (Final Rejection at page 4, ¶ 2). However, Takao already includes an insulating ring 11 surrounding electrode 7 (see Takao at page 4, lines 17-18) and the ring 11 supports ring 12 which extends over the electrode 7 and controls the size of the plasma to be the same size as the wafer 13 (Takao at page 4, lines 18-22). As shown in Figure 1 of Takao, the insulating ring 11 surrounds the outer periphery of electrode 7 and insulating ring 12 overlies the outer periphery of the electrode 7. In view of the presence of insulating rings 11 and 12 in Takao which protect the electrode assembly from exposure to plasma, the Official Action fails to explain how Takao would be modified to incorporate the insulating ring of Koch or why such a modification would be desirable. However, if the rejection is based on eliminating rings 11 and 12 of Takao and substituting ring 20 of Koch, the modification would go against Takao's teaching of controlling the size of the plasma with the ring 12.

In view of the forgoing, it is not clear from the rejection how Takao is to be modified to utilize isolated disclosures selectively removed from Koch. As a preliminary matter, the Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. MPEP §2143. Here, the Examiner has not clearly indicated how the teachings of the references would be combined and in view of Takao's insulating rings 11 and 12 which already are flush with electrode 7 and protect the electrode assembly from the plasma. Accordingly, the Official Action does not establish sufficient motivation to modify Takao to incorporate the insulating ring 20 of Koch.

The '456 patent incorporates Koch by reference in connection with housing 52 shown in Figures 3-4 of the '456 patent (see column 7, lines 13-20 of '456 patent). As shown in Figure 3 of Koch, the electrode 22 is secured to cover plate 28 by fasteners 34 (see column 8, lines 33-44 of Koch). Thus, Koch, like Takao, teaches the conventional electrodes prior to the '456 patent were mechanically attached to support structures. That is, the opposed surfaces of the electrode and support structures were unbonded surfaces. The '456 patent provides substantial benefits over such mechanically attached electrodes as high purity difficult to machine electrodes can be bonded to easy to machine less expensive support materials and the bond accommodates differential thermal expansion between different electrode and support frame materials.

The electrode 22 of Koch is illustrated as a single piece shaped to provide a circularly-shaped recess 26 closed by the cover plate 28 (see column 8, lines 33-38 of Koch). As explained in the '456 patent, while one-piece electrodes exhibit certain advantages (e.g., polycrystalline silicon is compatible with many plasma chemistries and anodized aluminum is inexpensive and easy to machine), no one material meets all electrode requirements (column 2, lines 8-18 of '456 patent). With the composite electrode of the '456 patent, expensive high purity but difficult to machine material can be used for the electrode disk and less expensive but easy to machine material can be used as the support frame. Thus, the '456 patent provides a novel electrode arrangement wherein an electrode disk 12 is bonded to a support ring 14 or support ring 14' incorporating a plate 15 entirely across the electrode or concentric rings 14a, 14b, 14c (see Figures 2A-C of '456 patent) with the lower surface of the electrode 12

exposed over its entire surface and the support ring 14 connects the electrode 12 to a water cooled plate 80 (see Figure 4 and column 8, lines 5-26 of '456 patent).

As explained above, the proposed combination of adding an insulating ring of Koch to Takao is not well founded as Takao already has an insulating ring. In Takao, the insulation ring (11) surrounds the upper electrode (7) and the electrode body (4), and a sealed ring (12) is extended from the bottom of the insulation ring (11) so as to overlie and protrude from the bottom edge of the upper electrode (7). (Takao translation at page 4, lines 15-20 and Figure 1). In Koch, the electrode housing 14 is sealed by an annular-shaped, ceramic insulating ring 20 surrounding a disk-shaped electrically conductive electrode 22 (see column 8, line 20 of Koch and Figure 3). The Koch electrode 22 is secured to the lower surface of the insulating ring 20 by means of a clamping ring 38 contacting the upper surface of the insulating ring and a plurality of fasteners 40. (column 8, lines 49-53 of Koch). Accordingly, there would be no reason to add the insulating ring of Koch to Takao.

Claims 1 and 2 are clearly patentable over the Takao/Koch combination since neither Takao nor Koch discloses a support frame connecting the opposed electrode to a thermal sink. Takao clamps electrode 7 to water cooled electrode 4 and Koch uses fasteners to attach electrode 22 to cover plate 28 and additional fasteners 40 and a clamping ring 38 secure electrode 22 to ceramic insulating ring 20 (column 8, lines 49-53 of Koch). Accordingly, Takao and Koch teach away from bonding Takao's electrode 7 to electrode body 4 or eliminating the ring 12 of Takao. However, even if Takao's electrode 7 was bonded to electrode 4, the resulting combination would lack a support frame connecting the electrode 4 to a thermal sink and the exposed face of electrode 7 would not be substantially free from protrusions.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. MPEP §2143. As to the first criteria, nothing in Takao or Koch suggests replacing components mentioned above in Takao (insulation ring 11 and/or sealed ring 12) with the ceramic insulating ring 20 of Koch nor does the Examiner point to any such motivation. Second, there must be a reasonable expectation of success. MPEP §2143. Setting aside the fact that the Examiner has not indicated how Takao and Koch are to be combined, the Examiner has failed to point out an expectation of success in replacing the Takao components with those disclosed in Koch. Third, the prior art references when combined must teach or suggest all the claim limitations. *Id.* The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Although it is not clear from the rejection how Takao is to be modified, if the rejection is based on modifying Takao by eliminating part 12 and bolting electrode 22 into ceramic insulating ring 20 (see column 8, line 20 of Koch), such a modification of Takao fails to provide (1) a support frame connecting the electrode to a thermal sink, (2) a support frame bonded to a back face of an electrode or (3) an electrode with the exposed face substantially free from protuberances. As all the claim limitations of Claims 1 and 2 are not taught or suggested, Claims 1 and 2 are clearly patentable over the combination of Takao and Koch. For the foregoing reasons, the Examiner's rejection is improper and should be reversed.

3. Rebuttal Evidence - Composite Electrode Advantages

Prior to the Appellants' invention, upper electrodes for parallel plate plasma reactors were generally formed from a single (or coated) material, such as polycrystalline silicon, graphite, aluminum, flame sprayed silicon powder on aluminum, or the like. While each of these materials enjoyed certain advantages, e.g. polycrystalline silicon is compatible with many plasma chemistries, anodized aluminum is relatively inexpensive and easy to fabricate, and graphite is readily machined and can be purified to semiconductor purity, no one material had been found to meet all electrode requirements. (Column 2, lines 8-18 of '456 Patent).

Thus, it would have been desirable at the time of the claimed invention to provide improved upper electrode constructions used in, *inter alia*, parallel plate plasma reactors. Such electrodes should possess desirable electrical and thermal properties, and should be compatible with many or all plasma chemistries. In particular, it would be desirable if such electrodes were relatively easy and inexpensive to fabricate. (Column 2, lines 19-25 of the '456 patent).

The claimed composite electrodes have a number of advantages over previous electrodes formed from a single material. The plate portion of the composite electrode which is exposed to plasma can be formed from material which is most suitable for the processing conditions with less concern for the cost of the material or the ability to machine the material. Thus, the material of choice can be dictated primarily by plasma chemistry and the desirability to minimize formation of particles and release of other contaminates. Similarly, the support frame can be composed of a material which has desired electrical, thermal, and structural

properties and which can be relatively easily machined or otherwise formed into a desired geometry, e.g. a ring. (Column 2, lines 52-66 of the '456 patent).

Additionally, one face of the plate is bonded to a support frame composed of an electrically and thermally conductive material, leaving the other face substantially flat and free from protuberances. (Column 2, lines 32-36 of the '456 patent). The clamped Takao electrode, on the other hand, suffers various disadvantages.

The claimed electrode assembly provides substantial improvements in temperature control while providing the economical advantage of allowing expensive electrode materials to be used with lower cost support frame materials. Moreover, the claimed electrode assembly overcomes the disadvantages of the Takao clamped electrode assembly which suffers from lack of uniform temperature and cracking of the electrode due to clamping pressure.

During plasma processing a semiconductor substrate, the electrode and support member are heated when the RF power is delivered to the electrode. Differences in coefficients of thermal expansion result in differential expansion of the electrode and support frame when heated.

In contrast, the claimed electrode assembly wherein a support frame composed of an electrically and thermally conductive material is bonded to a back face of the plate, does not allow abrasive movement between the frame and electrode during temperature changes, and thus does not cause cracking of the electrode because there is no clamp holding the electrode, and does not interfere with the uniform temperature distribution across the front face of the plate because

the front face is substantially free from protuberances. Such improved properties are a substantial improvement over the Takao electrode.

In view of Appellants' showing of superiority of properties over Takao (the closest prior art reference), Appellants respectfully submit that the evidence of nonobviousness outweighs any *prima facie* case of obviousness set forth in the final Official Action. See MPEP § 716.02(a)(II), evidence of unobvious or unexpected advantageous properties, such as superiority in a property the claimed compound shares with the prior art, can rebut *prima facie* obviousness. As such, the rejection of Claim 2 under 35 U.S.C. §103(a) should be reversed.

D. Rejection of Claim 6 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) in view of EP 346055 (Okazaki)

Claim 6 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Okazaki. The Official Action contends that:

1. The Rejection

> Okazaki teaches the support frame comprises a plurality of concentric rings secured to the opposite face of the electrode disk (figure 2, item 22). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the concentric rings on the opposite side of the disk in order to diffuse the glow discharge (Okazaki page 4). (Final Rejection at page 4, ¶ 2).

2. Claimed Subject Matter

Claim 6 depends from Claim 3 (which depends from Claim 1 and recites that the electrode is a disk) and recites that the support frame comprises a plurality of concentric rings secured to the opposite face of the electrode disk. As

explained in the '456 patent, the electrode assembly can include support rings 14a, 14b, 14c bonded to the upper surface of the electrode plate 12" and the multiple support rings enhances structural support as well as thermal and electrical contact while leaving direct access to apertures 16" (see Figure 2C and column 7, line 67 through column 8, line 4 of '456 patent). There is absolutely no suggestion in Takao or Okazaki of the claimed subject matter.

3. Claim Features Missing in Combined References

In the Official Action, Figure 2 of Okazaki is cited for disclosure of a support frame comprised of a plurality of concentric rings 22 secured to the opposite face of the electrode disk and it is alleged that it would have been obvious to modify Takao to "utilize the concentric rings on the opposite side of the disk in order to diffuse the glow discharge" (Final Rejection at page 4, ¶ 2). However, there are no "rings" in Okazaki and thus there can be no rings bonded to an electrode in Okazaki.

Figure 2 of Okazaki shows concentric circular grooves 22 in the surface of upper electrode 12 (see page 4, lines 47-55 of Okazaki). In view of the fact that there are no concentric "rings" secured to electrode 12 of Okazaki and thus no evidence to support the rejection, the combination of Takao and Okazaki cannot possibly suggest the combination of features recited in Claim 6. As Claim 6 is clearly patentable over Takao in view of Okazaki, the rejection should be reversed.

4. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Section C(3) and later in G(7). Such evidence is incorporated by reference in response to the rejection of Claim 6.

E. Rejection of Claim 7 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) in view of JP 61-243170 (Shigeru)

Claim 7 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Shigeru. The Official Action contends that:

1. The Rejection

> Shigeru teaches the support frame comprises a flat plate which is secured to and covers substantially the entire opposite face of the electrode disk (figure 1, item 3). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the flat plate covering the electrode disk in order to reduce the temperature elevation of the plate when bonded to the backing plate (see Shigeru page 2). (Final Rejection at ¶ bridging pages 4 and 5).

2. Claimed Subject Matter

Claim 7 depends from Claim 3 which depends from Claim 1. As pointed out above, Claim 1 recites that the support frame connects the electrode to a thermal sink, the electrode plate is bonded to the support frame and the exposed face of the plate is substantially free from protuberances. Claim 3 recites that the electrode plate comprises a disk and Claim 7 recites that the support frame comprises a flat plate which covers the electrode disk. Figure 2B of the '456 patent shows an example of a support frame comprising a ring 14' and plate 15 extending across the electrode 12'. In contrast, electrode 7 of Takao is not bonded to electrode 4 and ring 12 protrudes from the exposed surface at the outer edge of the electrode 7. Thus, the combination of Takao and Shigeru fails to produce the claimed features of (1) a support frame comprising a flat plate connected to a thermal sink, (2) an electrode bonded to such support frame and (3) a bonded electrode having a front face which is exposed and substantially free from protuberances.

3. Improper Hindsight Reconstruction of Prior Art

As in *In re Mercier*, 515 F2d 1161, 185 USPQ 774 (CCPA 1975), the rejection over Takao in view of Shigeru requires reliance on isolated teachings in the prior art (Shigeru) without considering the overall context within which those teachings are presented. This rejection illustrates that without the benefit of Appellants' disclosure, a person of ordinary skill in the art would not know what portions of the disclosure of Shigeru to consider. Such hindsight reconstruction of the prior art is improper and renders the rejection untenable.

4. The Modification of Takao Goes Against Takao's Teachings

Although it is not apparent from the rejection how the Examiner proposes to modify Takao, to the extent that the rejection proposes to eliminate the clamping ring 12 of Takao and bond electrode 7 to a flat plate rather than clamp the electrode 7 to the electrode 4 with the ring 12, such radical reconstruction of Takao would go against the teachings of Takao since Takao requires the ring 12 to clamp the electrode 7 against electrode 4 and make the plasma the same size as the wafer being etched (see translation of Takao at page 4, lines 20-22).

Takao requires the ring 12 to define the size of the plasma and any modification of Takao which would eliminate ring 12 of would go against Takao's teachings thus rendering the rejection improper. (See MPEP §2145 (X)(D) "References Teach away From the Invention .."). For this reason alone, the rejection is untenable and should be reversed.

5. Misinterpretation of Shigeru

At page 5 of the final rejection, Shigeru is alleged to disclose (1) the support frame comprises a flat plate, and (2) a flat plate covers the electrode disk (Figure 1,

item 3). However, Shigeru does not disclose a flat plate covering an electrode disk. Instead, the support plate 3 disclosed in Shigeru is bonded to a target material and the plate 3 is a cup shaped member called a "backing plate" having a flat upper surface, an annular sidewall to form a cylindrical space large enough to receive rotating magnet 4 and circulate water through cooling water path 5, an outwardly extending lower flange for attaching the plate to a surface through which the cooling water enters and exits the cylindrical space, and a vacuum seal 7 is located on the underside of the flange (see Figures 1 and 3 and page 3, lines 18-22 of Shigeru). The alleged "electrode disk" in Shigeru is a target material which is sputtered off the backing plate. As Shigeru has been misinterpreted in that there is no "electrode disk" in Shigeru, the rejection is untenable and should be reversed.

Moreover, absent impermissible hindsight, there is no motivation to combine the sputtering target of Shigeru with the etching apparatus of Takao. In Shigeru, the backing plate is of heat radiant material such as copper (Shigeru at page 2, lines 10-11) and the target is a metallic oxide such as silicon dioxide (Shigeru at page 1, lines 22-23, 26; page 2, lines 15, 18, 22, 26; page 3, lines 3, 4, 8, 10, 13-16, 26, 28, 30). In contrast, Takao discloses an electrode 7 of amorphous carbon having openings 10 across its width to inject reaction gas onto a semiconductor wafer and the outer edge of the electrode 7 is held between an annular portion of water cooled aluminum electrode 4 and a ring 12. Given the different functions of the amorphous carbon electrode 7 of Takao and the metallic oxide target of Shigeru, plus the fact that the combined teachings of Takao and Shigeru fail to suggest all of the claimed features, it is submitted that it would not have been obvious to a person of ordinary skill in the art to modify Takao in the manner set forth in the Official Action.

6. Problem Solved by Invention Not Recognized by Takao and Shigeru

The invention solves the problem of providing plasma compatible electrode materials bonded to easy to machine support materials without particle generation problems due to differential thermal contraction between dissimilar materials. In contrast, Takao states that differential thermal expansion of the amorphous carbon showerhead etching electrode is not a problem and Shigeru relates to different technology used to deposit films via sputtering.

In Shigeru's sputtering apparatus, a solid thin plate bonded to a backing plate is sputtered via collision with ionized argon (Shigeru at page 1, line 31-page 2, line 9). The metallic oxide (silicon dioxide) target material bonded to a heat radiant (copper) backing plate presents the problem of "burn out" resulting from "outbreak of over 100 degrees C" (Shigeru at page 2, lines 7-9). Shigeru discloses that stability of a sputtering film can be maintained by minimizing temperature elevation "when bonded to a backing plate" (Shigeru at page 2, lines 21-23) wherein a cooling system circulates water in the backing plate (Shigeru at page 2, lines 23-24). Shigeru's solution to a heat elevation problem in sputtering is addressed by providing desired adhesiveness between the backing plate 102 and the silicon dioxide plate 101 (Shigeru at page 2, lines 31-33). However, the problem addressed in Shigeru is not one faced by Takao since Takao does not relate to sputtering and Takao explicitly states that adequate cooling is effected by the water cooled electrode 4 to avoid cracking of the amorphous electrode 7 (see page 8, lines 2-8 of Takao).

In the rejection, motivation to "utilize the flat plate [of Shigeru] covering the electrode disk [of Takao]" is alleged based on a desire "to reduce the temperature

elevation of the plate when bonded to the backing plate" (final Official Action at page 5). However, Takao relates to an etching apparatus and stability of a sputtering film is not a problem which needs solving in Takao. As such, contrary to the position taken in the Official Action, a person of ordinary skill in the art would not have been motivated to look to Shigeru for solutions to a nonexistent problem in Takao.

7. **Proposed Modification Renders Takao Inoperable**

Takao does not disclose a backing plate covering the electrode 7 much less bonded thereto. In fact, covering the electrode of Takao would render the Takao apparatus inoperative as the openings 10 in Takao's electrode 7 would be blocked and thus prevent the reaction gas supplied by pipe 9 from flowing onto the surface of the semiconductor wafer 13 (Takao at page 7, lines 29-32). Thus, a person of ordinary skill in the art would not have been motivated to render the Takao apparatus inoperative by incorporating the backing plate of Shigeru.

Furthermore, Shigeru's process is only applicable to target plates of silicon dioxide immersed in fuming nitric acid to facilitate bonding via gold plating and indium solder. The Shigeru process has no applicability to the Takao electrode because of the apertures in the Takao electrode are necessary to distribute process gas in the etch reactor. In contrast, Shigeru seeks to make the silicon dioxide plate smooth and there can be no openings in the backing plate 3 or in the target, as otherwise cooling water from path 5 would leak into the chamber. Thus, because the proposed modification of Takao would render Takao unsatisfactory for its intended purpose, there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

8. Lack of Motivation, Lack of Reasonable Expectation of Success and Missing Claim Limitations

It is abundantly evident from the selective combination of Takao and Shigeru that the Examiner has used the '456 patent as a roadmap to selectively pick and choose elements from the prior art references to render obvious the claimed invention. In other words, the Examiner has engaged in impermissible hindsight by not offering any evidence of a motivation to combine. *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1143, 227 USPQ 543, 551 (Fed. Cir. 1985). In the Official Action, there is no reason for the Examiner's proposed selective combination of Takao and Shigeru. The Examiner's conclusory statement that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the flat plate covering the electrode disk in order to reduce the temperature elevation of the plate when bonded to the backing plate is an insufficient legal basis upon which to base this rejection.

The rejection over Takao in view of Shigeru clearly fails to meet the three basic criteria set out in *Vaeck, supra*. First, neither Takao nor Shigeru teach a support frame connecting an electrode to a thermal sink or an electrode bonded to such a support frame since Takao only discloses an amorphous carbon electrode 7 clamped to the annular bottom of aluminum electrode 4 and Shigeru only discloses a target material of a metal oxide (silicon dioxide) indium bonded to a backing plate made of copper. The Official Action contends that the motivation to bond Takao's electrode to a plate is based on a desire "to reduce the temperature elevation of the plate when bonded to the backing plate." However, Takao's plate is not bonded and thus cannot be subject to temperature elevation during bonding. The Official Action

fails to allege adequate motivation for bonding Takao's amorphous carbon electrode 7 to the bottom of aluminum electrode 4 and the Official Action does not explain how amorphous carbon could be bonded to aluminum. Because a plate covering the electrode disk of Takao for purposes of lowering temperature elevation during bonding would result in covering the gas passages in Takao's electrode, it is submitted that one of ordinary skill in the art would not have been motivated to render Takao's electrode inoperative by blocking the gas holes in favor of reducing temperature elevation to effect bonding a plate covering the holes. Second, as for the needed showing of a reasonable expectation of success, it is submitted that Shigeru does not teach how to bond amorphous carbon to aluminum and the result of covering Takao's gas holes in electrode 7 would not lead to a reasonable expectation of success of fabricating an operable showerhead electrode. Third, even if Takao and Shigeru were combined as proposed in the Official Action, the resulting combination is missing the claimed features of (1) a support frame connecting an electrode to a thermal sink, (2) a bond between such support frame and back face of the electrode and (3) an exposed face of the electrode which is substantially free from protuberances.

9. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Section C(3) and later in G(7). Such evidence is incorporated by reference and clearly rebuts any *prima facie* obviousness with regard to the rejection of Claim 7.

10. Conclusion

In summary, Shigeru relates to a sputtering target wherein an aperture free silicon dioxide plate 1 is fixed onto an aperture free heat radiating backing plate 3

and thus relates to a different apparatus which functions in a completely different manner than the showerhead electrode assembly disclosed by Takao. Sputtering targets are used to deposit films on substrates whereas Takao relates to etching patterns into films by passing etching gas through the electrode (see page 2, lines 1-6 of translation of Takao). Because an insufficient evidentiary basis has been used to maintain the rejection and the rebuttal evidence outweighs any *prima facie* case of obviousness set forth in the Official Action, it is submitted that Claim 7 is patentable over the combination of Takao and Shigeru.

F. Rejection of Claims 8 and 9 under 35 U.S.C. §103(a) over JP 01-204424 (Takao)

Claims 8-9 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao. The reasons for the rejection are set forth on page 5 of the Official Action. The Official Action contends that:

1. The Rejection

> Takao teaches a parallel plate electrode reactor to hold semiconductor wafers (page 2). Because Takao teaches substantially the same machine as applicants to perform plasma etching (page 2 and applicant's abstract), the claimed ranges would have been obvious in order to obtain a high precision etching apparatus (page 2 of Takao). That is, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process optimization, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980) (Final Office Rejection at page 5, ¶ 1).

2. Claimed Subject Matter

The rejection of claims 8-9 should be reversed on the basis that Claims 8 and 9 are patentable for at least the reasons that Claims 1, 3 and 5 are patentable over

Takao. Claim 8 depends from Claim 5 which defines the support frame as a ring and Claim 9 depends from Claim 8 and defines the thickness of the ring as 0.2 to 3 cm. As explained above, Takao fails to disclose a support frame connecting electrode 7 to a thermal sink. That is, if Takao's water cooled electrode 4 is considered the claimed thermal sink, there is no structure in Takao corresponding to the claimed support frame and if Takao's water cooled electrode 4 is considered the claimed support frame, there is no structure in Takao corresponding to the claimed thermal sink In either case, as there is no support ring in Takao, there can be no support ring in Takao having a thickness of 0.2 to 3 cm as recited in Claim 9.

Takao does not disclose the claimed range of electrode disk diameter and thickness or support ring diameter and thickness. The rejection acknowledges that Takao fails to disclose any disk diameter or thickness or any ring diameter and thickness. Absent some teaching in the prior art, it is improper to reject the claimed features as "obvious ...to choose." As Takao fails to disclose a support ring or suggest the claimed dimensions, the rejection of Claims 8-9 is improper and should be reversed.

3. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Section C(3) and later in G(7). Such evidence is incorporated by reference in response to the rejection of Claims 8 and 9.

G. Rejection of Claims 10-13 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) in view of JP 61-279672 (Yamada)

Claims 10-13 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Yamada. The Official Action contends that:

1. The Rejection

> Yamada teaches the plate is bonded to the support frame by means of a bonding layer, which has a low vapor pressure, bonding layer is formed by soldering (page 3, ll. 4-7). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the process of Takao to utilize bonding the support frame using indium in order to affix the target to the base (see Yamada page 3, ll. 1-20) (Final Rejection at ¶ bridging pages 5 and 6).

2. Claimed Subject Matter

Claim 10 depends from Claim 1 and recites that the electrode plate is bonded to the support frame by a bonding layer, Claim 11 depends from Claim 10 and recites that the bonding layer is of a material having a low vapor pressure, Claim 12 depends from Claim 11 and recites that the bonding layer is selected from indium, silver and metal filled epoxies, and Claim 13 depends from Claim 12 and recites that the bonding layer is formed by brazing, soldering or adhesion. As explained above, Takao fails to disclose a support frame connecting electrode 7 to a thermal sink and if water cooled electrode 4 is considered the claimed thermal sink, there is no structure in Takao corresponding to the claimed support frame and thus there can be no suggestion in the combination of Takao and Yamada of (1) a support frame connecting an electrode to a thermal sink, (2) a bond between such support frame and the electrode or (3) an exposed face substantially free from protuberances as Takao only provides an electrode 7 clamped to electrode 4 by ring 12 and ring 12 is required in Takao to control the size of the plasma.

3. Improper Hindsight Reconstruction of Prior Art

The rejection over Takao in view of Yamada requires reliance on isolated teachings in Yamada without considering the overall context within which those teachings are presented. This rejection illustrates that without the benefit of Appellants' disclosure, a person of ordinary skill in the art would not know what portions of the disclosure of Yamada to consider. Such hindsight reconstruction of the prior art is improper and renders the rejection untenable. *In re Mercier*, *supra*.

4. Lack of Motivation, Lack of Reasonable Expectation of Success and Missing Claim Features

The rejection over Takao in view of Yamada fails to meet the three basic criteria set forth in Vaeck, *supra*. First, neither Takao nor Yamada teaches an electrode bonded to a support frame since Takao only discloses an etching apparatus including an amorphous carbon electrode 7 clamped to the annular bottom of aluminum electrode 4 by ring 12 and Yamada only discloses a sputtering apparatus located below a substrate holder 30 holding a plurality of substrates 28 on which a film is formed by sputtering a target 34 made of material for the film to be formed on the substrates. The Official Action fails to establish the requisite motivation to incorporate isolated teachings in Yamada related to the sputtering in the etching apparatus of Takao. Further, Takao uses the ring 12 of insulating material to control the size of the plasma created by electrode 7 to be the size of the wafer 13 to be etched. To the extent the Official Action proposes to replace the ring 12 of Takao with a bond between electrode 7 and electrode 4, doing so would go against the teachings of Takao. Second, because the Official Action fails to provide any showing that amorphous carbon had been used as a sputtering material or that

amorphous carbon is capable of being soldered to aluminum, the Official Action fails to establish the required reasonable expectation of success in soldering Takao's amorphous carbon electrode 7 to aluminum electrode 4. Third, even if Takao and Yamada were combined as proposed in the Official Action, there is no support frame connecting electrode 7 to a thermal sink and because ring 12 is required to control the size of the plasma the resulting combination of Yamada and Takao lacks (1) a support frame connecting an electrode to a thermal sink, (2) a bond between such support frame and the electrode and (3) the exposed face of the electrode substantially free from protuberances.

5. Yamada Solves a Sputtering Problem Not Present in Takao

Yamada discloses an improved cooling system for cooling a target of a sputtering apparatus (Yamada at page 1, lines 27-29). Yamada discloses that in a conventional sputtering apparatus, the target was indirectly cooled because the target was attached to a packing plate and the packing plate was cooled (Yamada at page 2, lines 5-12). Yamada's apparatus cools the target directly by using cooling fluid which contacts the opposite side of the sputtering surface (Yamada at page 2, lines 14-16). Thus, Yamada provides various embodiments to achieve such direct cooling. In contrast, Takao explicitly states that the water cooled electrode 4 provides adequate cooling to the electrode 7 (see page 8, lines 2-8 of Takao). Thus, Takao does not share the cooling problem addressed in Yamada there would be no reason to look to Yamada for a solution to a problem which does not exist in Takao.

Yamada does not cool the target material at the edges of the target but rather supports the target at its edges to allow direct cooling of the target with water. To achieve this direct cooling, the target 34 can be soldered to projection 38 of fixing

member 36 (Yamada at page 3, lines 2-7, Figures 2-3), the target 34 can be soldered to annular fixing member 86 (Yamada at page 4, lines 7-23, Figure 4), the target 34 can be attached to annular protrusion 88 with bolts (Yamada at page 4, lines 24-28, Figure 5) or the target 34 can be fixed on a packing plate 94 having concentric grooves 96 which allow cooling water to contact the target (Yamada at page 4, lines 29-32). In each case, the target is arranged to allow cooling fluid to contact the unexposed side of the target and it is essential that a solder or O-ring seal be formed to prevent leakage of the cooling fluid. Such water cooling would render Takao's electrode inoperable and only hindsight would lead a person of ordinary skill in the art to selectively remove the teaching of soldering in Yamada and apply it to Takao. Although the Official Action fails to establish a reasonable expectation of success in soldering Takao's amorphous carbon electrode to the water cooled aluminum electrode 4, even if such could be done the result would be an electrode soldered to a thermal sink and thus fail to suggest (1) an electrode soldered to a support frame which is connected to a thermal sink and (2) an exposed face of the electrode substantially free from protuberances as there is no structure in Takao corresponding to the claimed thermal sink and support frame and the ring 12 of Takao is required to control the size of the plasma.

Although a hindsight reconstruction of Takao would fail to produce the claimed subject matter, insufficient motivation has been relied on in support of the rejection. In Takao, the electrode 7 is used to supply etching gas to etch a semiconductor wafer and cooling of the amorphous carbon electrode 7 is achieved through the water cooled aluminum electrode 4. Such an arrangement is completely different from Yamada which relates to sputtering apparatus to deposit films on

substrates and eliminates the conventional backing plate (such as in Shigeru) to achieve more efficient cooling of a target material intended to be sputtered. In view of the fact that the sputtering apparatus of Yamada functions in a completely different way than the etching apparatus of Takao, it is submitted that the Official Action fails to advance the required particular findings as to why a person of ordinary skill in the art, with no knowledge of the claimed invention, would have selected components from Yamada and combined them with Takao in the manner alleged in the Official Action.

6. No Substantial Evidence of Motivation to Combine

In the Official Action, Yamada is cited for disclosure of bonding a plate to a support frame with a bonding layer and it is alleged that it would have been obvious to modify Takao "to utilize bonding the support frame using indium in order to affix the target to the base" (Final Official Action at page 5). However, there is no teaching in the etch apparatus art to do so. Appellants were the first to propose bonding electrodes to support frames to obtain the benefits discussed above, i.e., the '456 patent provides an improved upper electrode assembly which (1) has desirable electrical and thermal properties, (2) is compatible with many different plasma chemistries and (3) is relatively easy and inexpensive to fabricate and overcomes problems such as cracking of electrodes due to excess clamping pressures or particles produced by differentially expanded surfaces clamped together. Takao and Yamada fail to suggest the claimed invention and the claimed invention provides substantial improvements thereby rebutting any *prima facie* obviousness based on these references.

Yamada provides various arrangements to allow direct cooling of the target and while one arrangement includes a target soldered to a projection 38, the purpose is to (1) allow cooling fluid from pipe 48 facing the lower surface of target 34 to fill space 54 and the target and (2) prevent the cooling water from leaking into the sputtering chamber. Thus, the target of Yamada is not analogous to the showerhead electrode of Takao since (1) the target of Yamada is used to deposit films whereas Takao uses the showerhead electrode to etch substrates and (2) Yamada's target must be free of gas passages to avoid the cooling water from leaking into the sputtering chamber, whereas Takao's showerhead electrode must include holes 10 to distribute etch gas in the chamber. Further, Takao achieves cooling of electrode 7 via contact with electrode 4 whereas Yamada flows cooling water against the target 34. Given the different uses and constructions of the Takao showerhead electrode and the Yamada sputtering target, the Examiner has not provided a proper legal basis for the obviousness rejection as particular findings are lacking as to why a person of ordinary skill in the art would have selected the isolated teaching of a soldered arrangement of Yamada and substituted it for the clamped arrangement of Takao. The rejection is instead based on an impermissible obvious to try or hindsight reconstruction of the prior art and should be reversed.

The Examiner has failed to establish that it would have been obvious to those of ordinary skill in the art at the time of the invention to provide an electrode plate bonded to the support frame by means of a bonding layer. The only source of a suggestion to use the particular bonding layer to bond the electrode plate to the support frame claimed in the '456 patent is Appellants' own disclosure of the invention. In other words, the Examiner has relied on impermissible hindsight in

making his determination of obviousness. *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992) (impermissible to engage in hindsight reconstruction of the claimed invention, using applicant's structure as a template and selecting elements from references to fill the gaps).

Yamada relates to improvements in sputtering and does not address Applicants' problem of particle generation due to differential expansion between an electrode such as a showerhead electrode and support member. As such, the prior art fails to recognize the problem Appellants' invention overcame. In determining the differences between the prior art and the claims, the question under 35 U.S.C. §103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed. Cir. 1983). Thus, discovering the source or cause of a problem is part of the "as a whole inquiry." MPEP §2141.02 III. "[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103." *In re Sponnoble*, 405 F.2d 578, 585, 160 USPQ 237, 243 (CCPA 1969).

Like Shigeru, Yamada relates to a sputtering target which is not used to flow reaction gas into a chamber and thus is not analogous to the showerhead electrode of Takao. Yamada's sputtering apparatus is used to sputter a substance constituting the target and adhere the substance onto surfaces of substrates by colliding a high-energy ion against a sputtering surface of a target consisting of the same substance

to be adhered to the substrates (Yamada, page 1, line 32 to page 2, line 2 of translation). That is, the sputter target is a consumable source of material to build up a layer on the substrates. By contrast, the etching apparatus of Takao uses a plasma of reaction gas supplied by a showerhead electrode to etch a substrate (Takao, page 3, lines 16-21 of translation). As stated in *In re Hedges*, 783 F.2d 1038, 1039, 228 USPQ 685, 686 (Fed.Cir. 1986); quoting from *In re Wesslau*, 353 F.2d 238, 241, 147 USPQ 391, 393 (CCPA 1965): "It is impermissible within the framework of section 103 to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art." The Examiner has ignored at least the teaching of Yamada that requires a cooling fluid in direct contact with the back of the target, that is, a conventional sputtering apparatus was not able to achieve the improvements disclosed by Yamada because a target was indirectly cooled and the Examiner has ignored the requirement that there be no apertures in the target. By ignoring these teachings in Yamada, the Examiner attempts to pick and choose other portions of Yamada to incorporate in Takao. However, such picking and choosing is an improper basis for an obviousness rejection.

As mentioned above, in one arrangement the Yamada target 34 (which is consumed and deposited as a film on substrates 28) is bonded at the periphery rather than completely across a backing plate to provide a water seal and reduce diffusion of solder into the target compared to a target bonded entirely across its surface (see page 3, lines 19-33 of Yamada translation). To the extent that Yamada

reduced diffusion of solder in sputter targets, such is irrelevant with respect to Takao's etching apparatus.

There was no problem of solder diffusion into showerhead electrodes at the time of Appellants' invention since Appellants were the first to invent such a novel bonded electrode arrangement. Given the different structures and functions of Yamada's sputtering target (sputter films and prevent diffusion of solder into the target) compared to Takao's clamped showerhead electrode in an etching apparatus, it is submitted that the Examiner has failed to establish that persons of ordinary skill in the art at the time of invention would have been led by the teachings of Yamada to bond the electrode 7 to the ring 4 of Takao or use solder to do so for the purposes of the bond in Yamada, i.e., reducing diffusion of solder into the target. The only source of a suggestion to use a bond such as a solder joint to attach a showerhead electrode to a support member is the disclosure in the '456 patent. Therefore, the Examiner has relied on impermissible hindsight in making a determination of obviousness. *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992) ("It is impermissible to engage in hindsight reconstruction of the claimed invention, using the applicant's structure as a template and selecting elements from references to fill the gaps"). Therefore, the rejection should be reversed.

In addition to the above, the Examiner has failed to identify where in the prior art one of ordinary skill would have found a disclosure or suggestion which would have led him to make the proposed modification. See *In re Kotzab*, 27 F.3d 1365, at 1371, 55 USPQ2d 1313, at 1317 (Fed. Cir. 2000) wherein the court stated that particular findings must be made as to the reason the skilled artisan, with no

knowledge of the claimed invention, would have selected the components for combination in the manner claimed. The absence of such particular findings in support of the rejection of Claims 10-13 renders the rejection improper.

7. Rebuttal Evidence

Takao fails to address the thermal expansion problem solved by the '456 patent. Takao discloses the radio frequency (RF) power source (26) imposes a high frequency electric power between the upper electrode (7) and the lower electrode (14) making plasma of the reaction gas, thereby etching the semiconductor wafer (13). Takao discloses that the upper electrode (7) and the lower electrode (14) are heated and thermally expand due to the heat from the imposed high frequency electric power. Takao recognizes that because the upper electrode (7) is made of amorphous carbon and the electrode body (4) contacting the upper electrode (7) is made of aluminum, cracking could be caused by the difference in coefficient of thermal expansion. In order to prevent this cracking, Takao discloses that cooling water is supplied from a cooling means into the flow path (5) to indirectly cool the upper electrode (7). (Takao translation at page 7, lines 32-33 to page 8, lines 1-8).

Takao explicitly states that the showerhead electrode is sufficiently cooled to avoid the problem of differential expansion and contraction solved by the '456 patent. Given that Takao states that the electrode 7 is adequately cooled by water cooled electrode 4 and thus does not exhibit the problem solved by the '456 patent, there can be no motivation to adopt Appellants' solution, i.e., bond Takao's upper electrode (7) to the electrode body (4). However, even if Takao's electrode 7 was bonded to water cooled electrode 4 and the electrode 4 is considered either a thermal sink or a support frame, the combination of features recited in Claim 1 would

not be met because there would be no support frame connecting electrode 7 to a thermal sink.

The bonded electrode claimed in the '456 patent avoids (1) relative motion and resulting contamination dust, (2) development of gaps that would decrease the electrical and thermal contact between the upper electrode and the support body and (3) accommodates strains due to the differential in coefficients of thermal expansion. Such improvements over the clamped electrode of Takao are indicia of unobviousness which rebut any *prima facie* obviousness based on the combination of Takao and Yamada.

In Takao, cracking of the amorphous carbon is avoided by using cooling water to indirectly cool the amorphous carbon showerhead electrode 7 (Takao, page 8, lines 6-8 of translation). In contrast, the bonded electrode according to the '456 patent can include a brittle electrode material bonded to a compliant easy to machine support frame composed of an electrically and thermally conductive material bonded to a back face of the plate so as to allow differential expansion and contraction due to inherent elastic limits of the bonding layer. Use of the bonded electrode avoids the potential for dusting caused by relative movement of a showerhead electrode and clamping structure. This relative movement results in dusting or particles breaking free from the abrasion of the clamped surfaces against each other. Such dusting and loose particles subsequently contaminate the plasma chamber and create defects in the wafer being processed.

The bonded electrode according to the '456 patent can avoid such particle generation problems inherent in the clamped structure of Takao. The '456 patent discloses the advantage of a bonded electrode in reducing particles (see Summary

of Invention, 3rd paragraph). Such "improvement" over the clamped showerhead electrode of Takao rebuts any *prima facie* obviousness based on Takao.

The claimed electrode provides several advantages compared to the clamped electrode of Takao. For example, a support frame composed of an electrically and thermally conductive material bonded to a back face of the plate, whereby the support frame is connected to the electrical source and thermal sink and a front face of the plate which is exposed to the first electrode is substantially free from protuberances as recited in Claim 1 and (1) avoids abrasive movement between the frame and electrode during temperature changes, (2) avoids cracking of the electrode due to over tightness of the clamp holding the electrode, and (3) avoids disturbing the plasma due to the RF coupling and/or physical presence effects of the clamp overlying the outer portion of the electrode. Clamping necessarily leaves minute gaps between the electrode and the electrically and thermally conductive support frame. And over tightening the clamps in an attempt to eliminate the gaps leads to cracking of the electrode. The gaps cause increases in temperature and uneven voltages across the face of the electrode. Uneven voltages also lead to higher temperatures on parts of the electrode. Higher temperatures are deleterious to the electrode and lead to rapid erosion and shortening of service life. Such disadvantages are overcome with the bonded electrode according to the '456 patent and rebut any *prima facie* case of obviousness based on Takao.

As stated in MPEP § 716.02(a)(II), evidence of unobvious or unexpected advantageous properties, such as superiority in a property the claimed element shares with the prior art, can rebut *prima facie* obviousness. "Evidence that a compound is unexpectedly superior in one of a spectrum of common properties . . .

can be enough to rebut a *prima facie* case of obviousness." No set number of examples of superiority is required. *In re Chupp*, 816 F.2d 643, 646, 2 USPQ2d 1437, 1439 (Fed. Cir. 1987). Additionally, the omission of an element and retention of its function is an indicia of unobviousness. *In re Edge*, 359 F.2d 896, 149 USPQ 556 (CCPA 1966); MPEP § 2144.04 (II)(B). The '456 patent clearly discloses superior thermal and electrical contact between the support frame and the electrode via bonding and thus provides superiority in properties compared to Takao's clamped showerhead electrode which clearly presents sources of particle contamination and/or introduce undesired edge effects on the plasma due to changes in RF coupling or physically disturbing the plasma. Therefore, Appellants submit that any *prima facie* case of obviousness is outweighed by the evidence of secondary considerations.

8. Conclusion

For the reasons set forth above, the Official Action fails to set forth a *prima facie* case of obviousness with respect to the rejection of Claims 10-13 and the rebuttal evidence overcomes and *prima facie* case of obviousness with regard to Claims 10-13. Accordingly, the rejection of Claims 10-13 should be reversed.

H. Rejection of Claim 14 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) and JP 61-279672 (Yamada) and further in view of JP 61-243170 (Shigeru)

Claim 14 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and Yamada and further in view of Shigeru. The reasons for the rejection are set forth on page 6 of the Official Action. The Official Action contends that:

1. The Rejection

> Shigeru teaches wherein at least one of the plate and the support frame is metallized (page 2, ll. 14-20). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Takao and Yamada to utilize metallizing one of the plate and the support frame in order to form a strong bond between the indium and the substrate (see Shigeru page 2). (Final Rejection, page 6).

2. The Claimed Subject Matter

Claim 14 depends from Claim 13 (which depends from interdependent Claims 12, 11, 10 and 1) and recites that at least one of the plate and the support frame is metallized in the region to be bonded prior to brazing, soldering or adhesion. Claim 14 is patentable over the combination of Takao, Yamada and Shigeru for at least the reasons discussed above in connection with Claims 1 and 10-13. As explained above, whether Takao's water cooled electrode 4 is considered the claimed support frame or thermal sink, Takao fails to disclose a support frame and a thermal sink wherein the electrode 7 is connected to the thermal sink by the support frame. Further, as the ring 12 of Takao is essential to control the size of the plasma, even if Takao is reconstructed as proposed in the Official Action, the electrode 7 would not be substantially free from protuberances. Thus, the applied references cannot suggest all of the claimed features which includes (1) a support frame connected to a thermal sink, (2) a bond between such support frame and the electrode and (3) the exposed face of the electrode substantially free from protuberances.

3. Lack of Motivation to Combine Shigeru and Yamada With Takao

In the Official Action, Shigeru is cited for disclosure of metallizing the plate or support frame and it is alleged that it would have been obvious to modify Takao to

utilize metallizing the plate or support frame "in order to form a strong bond between the indium and the substrate" (Final Official Action at page 6, ¶ 1 and page 8, ¶ 2). However, as explained above, Takao does not recognize the problem solved by the inventors of the '456 patent. "[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103." *In re Sponnoble*, 405 F.2d 578, 585, 160 USPQ 237, 243 (CCPA 1969).

In *In re Sponnoble*, the claim was directed to a plural compartment mixing vial wherein a center seal plug was placed between two compartments for temporarily isolating a liquid-containing compartment from a solids-containing compartment. The claim differed from the prior art in the selection of butyl rubber with a silicone coating as the plug material instead of natural rubber. The prior art recognized that leakage from the liquid to the solids compartment was a problem, and considered the problem to be a result of moisture passing around the center plug because of microscopic fissures inherently present in molded or blown glass. The court found the inventor discovered the cause of moisture transmission was through the center plug, and there was no teaching in the prior art which would suggest the necessity of selecting applicant"s plug material which was more impervious to liquids than the natural rubber plug of the prior art.

In the '456 patent, the inventors recognized the problem of manufacturing an electrode to meet requirements of compatibility with the plasma chemistries, while being relatively inexpensive, easy to fabricate, and purifiable to semiconductor purity

(col. 2, lines 8-18 of the '456 patent). The plate portion of the composite electrode which is exposed to plasma can be formed from material which is most suitable for the processing conditions with less concern for the cost of the material or the ability to machine the material. Thus, the material of choice can be dictated primarily by plasma chemistry and the desirability to minimize formation of particles and release of other contaminates. Similarly, the support frame can be composed of a material which has desired electrical, thermal, and structural properties and which can be relatively easily machined or otherwise formed into a desired geometry, e.g. a ring. (Column 2, lines 52-66)

As explained above, Yamada and Shigeru relate to sputtering apparatus wherein the bonded target is free of gas apertures, an arrangement contrary to Takao's showerhead electrode. Sputtering targets are used to deposit films on substrates whereas Takao relates to etching patterns into films (see page 2, lines 1-6 of translation of Takao). As neither Shigeru nor Takao relates to plasma etching or electrodes of plasma etching apparatus, it is submitted that a person of ordinary skill in the art would not have been led by the teachings of Shigeru or Yamada to modify Takao in the manner proposed in the Official Action. In addition, the Examiner has not adequately explained how Shigeru and Yamada could be combined with Takao. For example, as explained above, Yamada supplies cooling water to contact the back of the sputtering target, whereas Takao discloses an electrode with apertures for supplying the plasma gas which would leak cooling water into the plasma chamber. Likewise, Shigeru discloses a cooling plate contacting the entire back surface of the sputtering target, to prevent the target material from instantly burning out (Shigeru, page 2, lines 7-8 of translation). Applying the teachings of Shigeru and

Yamada to Takao as proposed in the final rejection requires impermissible picking and choosing isolated disclosures of the secondary references with the only motivation coming from Appellants' disclosure. Such hindsight reconstruction of the prior art is improper.

An adequate showing of motivation to combine requires evidence that a person of ordinary skill in the art would, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. *Ecolochem Inc. v Southern Calif. Edison Co.*, 227 F.3d 1361, 1375, 56 USPQ2d 1065, 1075 (Fed. Cir. 2000) quoting *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1456 (Fed. Cir. 1998). In the present case, the Examiner has not shown that one of ordinary skill would have found proper motivation to select the features from Yamada and Shigeru related to bonding and combined them with Takao absent knowledge of the claimed invention. Because the only reason or suggestion to modify the teachings of Takao comes from Appellants' disclosure, the rejection is improper and should be reversed.

4. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claim 14.

I. Rejection of Claim 15 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) and JP 61-279672 (Yamada) and further in view of JP 61-243170 (Shigeru)

Claim 15 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and Yamada and further in view of Shigeru. The Official Action contends that:

1. The Rejection

> Shigeru teaches the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding (p. 2, ll. 19-20 and figure 3, item 102). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Takao and Yamada to utilize the bonding layer is free from voids and uniform electrical and thermal conductivities in order to form a strong bond to the substrate (see Shigeru page 2). (Final Rejection at page 6, ¶ 1).

2. The Claimed Subject Matter

Claim 15 depends from Claim 10 (which depends from Claim 1) and sets forth that the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding. Claim 15 is patentable over the combination of Takao, Yamada and Shigeru for at least the reasons discussed above in connection with Claim 10. As explained above, whether Takao's water cooled electrode 4 is considered the claimed support frame or thermal sink, Takao fails to disclose a support frame and a thermal sink wherein the electrode 7 is connected to the thermal sink by the support frame. Further, as the ring 12 of Takao is essential to control the size of the plasma, even if Takao is reconstructed as proposed in the Official Action, the electrode 7 would not be substantially free from protuberances. Thus, the applied references cannot suggest all of the claimed features which includes (1) a support frame connected to a thermal

sink, (2) a bond between such support frame and the electrode and (3) the exposed face of the electrode substantially free from protuberances.

3. Lack of Motivation to Combine Shigeru and Yamada With Takao

As mentioned above, rejections under 35 U.S.C. §103 must be based on "evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness" *In re Lee*, 277 F3d 1338, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002). A showing of a suggestion, teaching, or motivation to combine the prior art references is an essential component of an obviousness holding and "particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed." (Emphasis Added). *Id.* Conclusory statements regarding what is "basic knowledge" and "common sense" cannot be used to cure deficiencies of the cited references.

In the rejection, it is stated that page 2, lines 19-20 of Shigeru "teaches the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding" (Official Action at page 6). However, such language is not found in Shigeru. Instead, the quoted language is taken from Appellants' Claim 15. The quoted portion of Shigeru in the Official Action actually states that bonding is "carried out in a vacuum chamber to prevent voids" (Shigeru at page 2, lines 19-20). In Shigeru, a bonding layer of indium is applied to a silicon dioxide plate, a non-electrically conductive material. As such target material is non-electrically conductive, there is no basis for the Examiner's allegation that Shigeru "teaches" that the bonding layer provides "uniform electrical" conductivity.

Thus, the Official Action errs in citing Shigeru for a teaching of using a bonding layer to achieve uniform electrical conductivity.

The Official Action also cites Shigeru for a teaching of using a bonding layer to obtain uniform thermal conductivity. However, Shigeru seeks to prevent temperature elevation of the metallic oxide target material and stability of sputtering film formation (see page 3, lines 24-27 of Shigeru). Other than impermissible hindsight, there would be no reason to consider Shigeru's teachings of using a bonding layer to obtain stability of sputtering film formation as motivation for bonding the amorphous carbon electrode 7 of Takao to the water cooled aluminum electrode 4. And, as explained above, Shigeru does not teach use of the bonding layer to obtain uniform electrical conductivity to the non-electrically conductive silicon dioxide target material. Accordingly, the Official Action fails to advance adequate motivation for modifying Takao to have a bonding layer between the amorphous carbon electrode 7 and the water cooled aluminum electrode 4.

Yamada and Shigeru relate to sputtering apparatus and thus the structures and function of the sputtering targets are nonanalogous to the showerhead electrode of Takao. Sputtering targets are used to deposit films on substrates whereas Takao relates to etching patterns into films (see page 2, lines 1-6 of translation of Takao). As Shigeru does not relate to showerhead electrodes of plasma etching apparatus, it is submitted that a person of ordinary skill in the art would not have been led by the teachings of Shigeru to modify Takao in the manner proposed in the Official Action. In addition, the Examiner has not adequately explained how Shigeru and Yamada could be combined with Takao. For example, as explained above, Yamada supplies cooling water to contact the back of the sputtering target, whereas Takao discloses

an electrode with apertures for supplying the plasma gas which would leak cooling water into the plasma chamber rendering the prior art unsatisfactory. Likewise, Shigeru discloses a cooling plate contacting the entire back surface of the sputtering target, otherwise the target material can instantly burn out (Shigeru, page 2, lines 7-8 of translation). Modifying Takao to incorporate the aperture free backing plate of Shigeru leads to an inoperative arrangement. Modifying Takao to incorporate an aperture free target of Yamada also leads to an inoperative arrangement. If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

It is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983). Here, Shigeru discloses a backing plate to cool a sputtering target bonded to the backing plate (see, for example, Figures 1-3 and page 2, lines 7-11 of translation), whereas Yamada, discloses that a conventional sputtering apparatus was not able to achieve the improvements disclosed by Yamada because a target was indirectly cooled by attaching a target on a backing plate and cooling the backing plate. (Yamada translation at page 2, lines 10-12) Yamada solders an aperture free target 34 to the fixing member 36 to allow water cooling of the backside of the target. (Yamada translation at page 4, lines 29-32). Because the Examiner's selective combination of Shigeru and Yamada is clearly based on improper hindsight, the rejection is improper and should be reversed.

4. Lack of Reasonable Expectation of Success

The Official Action fails to allege a reasonable expectation of success in bonding Takao's amorphous carbon electrode 7 to the bottom of aluminum electrode 4 as the Official Action does not explain how amorphous carbon could be bonded to aluminum. Shigeru discloses an arrangement wherein the entire face of the target material is covered by an aperture free plate. As explained in connection with the rejection of Claim 7, it would not have been obvious to follow the teachings of Shigeru (wherein a cup-shaped plate covers the target material) since covering the electrode disk of Takao for Shigeru's purposes of lowering temperature elevation during bonding would cover the gas passages in Takao's electrode and render it inoperative. As for the needed showing of a reasonable expectation of success, it is submitted that Shigeru does not teach how to bond amorphous carbon to aluminum and the result of covering Takao's gas holes in electrode 7 would not lead to a reasonable expectation of success of fabricating an operable showerhead electrode.

5. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claim 15.

J. Rejection of Claim 20 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) and EP 346055 (Okazaki)

Claim 20 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Okazaki. The Official Action contends that:

1. The Rejection

> Okazaki teaches the support frame comprises a plurality of concentric rings secured to the opposite face of the electrode disk

(figure 2, item 22). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the concentric rings on the opposite side of the disk in order to diffuse the glow discharge (Okazaki page 4). (Final Rejection at pages 6-7).

2. Claimed Subject Matter

Claim 20 depends from Claim 18 and recites that the support frame comprises a plurality of concentric rings secured to the opposite face of the electrode disk. As explained in the '456 patent, the electrode assembly can include support rings 14a, 14b, 14c bonded to the upper surface of the electrode plate 12" and the multiple support rings enhances structural support as well as thermal and electrical contact while leaving direct access to apertures 16" (see Figure 2C and column 7, line 67 through column 8, line 4 of '456 patent). There is absolutely no suggestion in Takao or Okazaki of the claimed subject matter.

3. Claim Features Missing in Combined References

In the Official Action, Figure 2 of Okazaki is cited for disclosure of a support frame comprised of a plurality of concentric rings 22 secured to the opposite face of the electrode disk and it is alleged that it would have been obvious to modify Takao to "utilize the concentric rings on the opposite side of the disk in order to diffuse the glow discharge" (Final Rejection at page 4, ¶ 2). However, there are no "rings" in Okazaki and thus there can be no rings bonded to an electrode in Okazaki.

Figure 2 of Okazaki shows concentric circular grooves 22 in the surface of upper electrode 12 (see page 4, lines 47-55 of Okazaki). In view of the fact that there are no concentric "rings" secured to electrode 12 of Okazaki and thus no evidence to support the rejection, the combination of Takao and Okazaki cannot

possibly suggest the combination of features recited in Claim 20. As Claim 20 is clearly patentable over Takao in view of Okazaki, the rejection should be reversed.

4. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claim 20.

K. Rejection of Claim 21 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) and JP 61-243170 (Shigeru)

Claim 21 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Shigeru. The Official Action contends that:

1. The Rejection

> Shigeru teaches the support frame comprises a flat plate which is secured to and covers substantially the entire opposite face of the electrode disk (figure 1, item 3). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the flat plate covering the electrode disk in order to reduce the temperature elevation of the plate when bonded to the backing plate (see Shigeru page 2). (Final Rejection at page 7, ¶ 1).

2. Claimed Subject Matter

Claim 21 is patentable over Takao in view of Shigeru for at least the reasons discussed above in connection with Claim 7. Claim 21 depends from Claim 18 and recites that the support ring includes an interior plate which contacts the entire one face of the disk. In contrast, electrode 7 of Takao is not bonded to electrode 4 and ring 12 protrudes from the exposed surface at the outer edge of the electrode 7. Thus, the combination of Takao and Shigeru fails to produce the claimed features of (1) a support frame connected to a thermal sink, (2) an electrode bonded to such

support frame and (3) a bonded electrode having a front face which is exposed and substantially free from protuberances.

3. Improper Hindsight Reconstruction of Prior Art

As in *In re Mercier*, 515 F2d 1161, 185 USPQ 774 (CCPA 1975), the rejection over Takao in view of Shigeru requires reliance on isolated teachings in the prior art (Shigeru) without considering the overall context within which those teachings are presented. This rejection illustrates that without the benefit of Appellants' disclosure, a person of ordinary skill in the art would not know what portions of the disclosure of Shigeru to consider. Such hindsight reconstruction of the prior art is improper and renders the rejection untenable.

4. The Modification of Takao Goes Against Takao's Teachings

Although it is not apparent from the rejection how the Examiner proposes to modify Takao, to the extent that the rejection proposes to eliminate the clamping ring 12 of Takao and bond electrode 7 to a flat plate rather than clamp the electrode 7 to the electrode 4 with the ring 12, such radical reconstruction of Takao would go against the teachings of Takao since Takao requires the ring 12 to clamp the electrode 7 against electrode 4 and make the plasma the same size as the wafer being etched (see translation of Takao at page 4, lines 20-22).

Takao requires the ring 12 to define the size of the plasma and any modification of Takao which would eliminate ring 12 of would go against Takao's teachings thus rendering the rejection improper. (See MPEP §2145 (X)(D) "References Teach away From the Invention .."). For this reason alone, the rejection is untenable and should be reversed.

5. Misinterpretation of Shigeru

At page 7 of the final rejection, Shigeru is alleged to disclose (1) the support frame comprises a flat plate, and (2) a flat plate covers the electrode disk (Figure 1, item 3). However, Shigeru does not disclose a flat plate covering an electrode disk. Instead, the support plate 3 disclosed in Shigeru is a cup shaped member called a "backing plate" having a flat upper surface, an annular sidewall to form a cylindrical space large enough to receive rotating magnet 4 and circulate water through cooling water path 5, an outwardly extending lower flange for attaching the plate to a surface through which the cooling water enters and exits the cylindrical space, and a vacuum seal 7 is located on the underside of the flange (see Figures 1 and 3 and page 3, lines 18-22 of Shigeru). The alleged "electrode disk" in Shigeru is a target material which is sputtered off the backing plate. As Shigeru has been misinterpreted in that there is no "electrode disk" in Shigeru, the rejection is untenable and should be reversed.

Moreover, absent impermissible hindsight, there is no motivation to combine the sputtering target of Shigeru with the etching apparatus of Takao. In Shigeru, the backing plate is of heat radiant material such as copper (Shigeru at page 2, lines 10-11) and the target is a metallic oxide such as silicon dioxide (Shigeru at page 1, lines 22-23, 26; page 2, lines 15, 18, 22, 26; page 3, lines 3, 4, 8, 10, 13-16, 26, 28, 30). In contrast, Takao discloses an electrode 7 of amorphous carbon having openings 10 across its width to inject reaction gas onto a semiconductor wafer and the outer edge of the electrode 7 is held between an annular portion of water cooled aluminum electrode 4 and a ring 12. Given the different functions of the amorphous carbon electrode 7 of Takao and the metallic oxide target of Shigeru, plus the fact that the combined teachings of Takao and Shigeru fail to suggest all of the claimed features,

it is submitted that it would not have been obvious to a person of ordinary skill in the art to modify Takao in the manner set forth in the Official Action.

6. Problem Solved by Invention Not Recognized in Takao or Shigeru

The invention claimed in the '456 patent solves a problem of particle generation due to differential expansion between plasma compatible electrode materials and easy to machine support frame materials. In contrast, Takao discloses a plasma etching apparatus and explicitly states that cracking of the amorphous carbon showerhead electrode 7 is not a problem due to the cooling provided by water cooled electrode 4. Shigeru, on the other hand, does not relate to etching apparatus and instead relates to sputtering technology. As such, neither Takao nor Shigeru recognize the problem solved by the claimed invention.

Shigeru relates to sputtering apparatus wherein a solid thin plate bonded to a backing plate is sputtered via collision with ionized argon (Shigeru at page 1, line 31-page 2, line 9). In Shigeru, a metallic oxide (silicon dioxide) target material bonded to a heat radiant (copper) backing plate presents the problem of "burn out" resulting from "outbreak of over 100 degrees C" (Shigeru at page 2, lines 7-9). Shigeru discloses that stability of a sputtering film can be maintained by minimizing temperature elevation "when bonded to a backing plate" (Shigeru at page 2, lines 21-23) wherein a cooling system circulates water in the backing plate (Shigeru at page 2, lines 23-24). Shigeru's solution to the heat elevation problem is addressed by providing desired adhesiveness between the backing plate 102 and the silicon dioxide plate 101 (Shigeru at page 2, lines 31-33). However, the problem addressed in Shigeru is not one faced by Takao. Takao explicitly states that

adequate cooling is effected by the water cooled electrode 4 to avoid cracking of the amorphous electrode 7 (see page 8, lines 2-8 of Takao).

In the rejection, motivation to "utilize the flat plate [of Shigeru] covering the electrode disk [of Takao]" is alleged based on a desire "to reduce the temperature elevation of the plate when bonded to the backing plate" (final Official Action at page 5). However, Takao relates to an etching apparatus and stability of a sputtering film is not a problem which needs solving in Takao. As such, contrary to the position taken in the Official Action, a person of ordinary skill in the art would not have been motivated to look to Shigeru for solutions to a nonexistent problem in Takao.

7. Proposed Modification Renders Takao Inoperable

Takao does not disclose a backing plate covering the electrode 7 much less bonded thereto. In fact, covering the electrode of Takao would render the Takao apparatus inoperative as the openings 10 in Takao's electrode 7 would be blocked and thus prevent the reaction gas supplied by pipe 9 from flowing onto the surface of the semiconductor wafer 13 (Takao at page 7, lines 29-32). Thus, a person of ordinary skill in the art would not have been motivated to render the Takao apparatus inoperative by incorporating the backing plate of Shigeru.

Furthermore, Shigeru's process is only applicable to target plates of silicon dioxide immersed in fuming nitric acid to facilitate bonding via gold plating and indium solder. The Shigeru process has no applicability to the Takao electrode because of the apertures in the Takao electrode are necessary to distribute process gas in the etch reactor. In contrast, Shigeru seeks to make the silicon dioxide plate smooth and there can be no openings in the backing plate 3 or in the target, as otherwise cooling water from path 5 would leak into the chamber. Thus, because the

proposed modification of Takao would render Takao unsatisfactory for its intended purpose, there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

8. Lack of Motivation, Lack of Reasonable Expectation of Success and Missing Claim Limitations

It is abundantly evident from the selective combination of Takao and Shigeru that the Examiner has used the '456 patent as a roadmap to selectively pick and choose elements from the prior art references to render obvious the claimed invention. In other words, the Examiner has engaged in impermissible hindsight by not offering any evidence of a motivation to combine. *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1143, 227 USPQ 543, 551 (Fed. Cir. 1985). In the Official Action, there is no reason for the Examiner's proposed selective combination of Takao and Shigeru. The Examiner's conclusory statement that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the flat plate covering the electrode disk in order to reduce the temperature elevation of the plate when bonded to the backing plate is an insufficient legal basis upon which to base this rejection.

The rejection over Takao in view of Shigeru clearly fails to meet the three basic criteria set out in *Vaeck, supra*. First, neither Takao nor Shigeru teach a support frame connecting an electrode to a thermal sink or an electrode bonded to such a support frame since Takao only discloses an amorphous carbon electrode 7 clamped to the annular bottom of aluminum electrode 4 and Shigeru only discloses a target material of a metal oxide (silicon dioxide) indium bonded to a backing plate made of copper. The Official Action contends that the motivation to bond Takao's

electrode to a plate is based on a desire "to reduce the temperature elevation of the plate when bonded to the backing plate." However, Takao's plate is not bonded and thus cannot be subject to temperature elevation during bonding. The Official Action fails to allege adequate motivation for bonding Takao's amorphous carbon electrode 7 to the bottom of aluminum electrode 4 and the Official Action does not explain how amorphous carbon could be bonded to aluminum. Because a plate covering the electrode disk of Takao for purposes of lowering temperature elevation during bonding would result in covering the gas passages in Takao's electrode, it is submitted that one of ordinary skill in the art would not have been motivated to render Takao's electrode inoperative by blocking the gas holes in favor of reducing temperature elevation to effect bonding a plate covering the holes. Second, as for the needed showing of a reasonable expectation of success, it is submitted that Shigeru does not teach how to bond amorphous carbon to aluminum and the result of covering Takao's gas holes in electrode 7 would not lead to a reasonable expectation of success of fabricating an operable showerhead electrode. Third, even if Takao and Shigeru were combined as proposed in the Official Action, the resulting combination is missing the claimed features of (1) a support frame connecting an electrode to a thermal sink, (2) a bond between such support frame and back face of the electrode and (3) an exposed face of the electrode which is substantially free from protuberances.

9. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference and clearly rebuts any *prima facie* obviousness with regard to the rejection of Claim 21.

10. Conclusion

In summary, Shigeru relates to a sputtering target wherein an aperture free silicon dioxide plate 1 is fixed onto an aperture free heat radiating backing plate 3 and thus relates to a different apparatus which functions in a completely different manner than the showerhead electrode assembly disclosed by Takao. Sputtering targets are used to deposit films on substrates whereas Takao relates to etching patterns into films by passing etching gas through the electrode (see page 2, lines 1-6 of translation of Takao). Because an insufficient evidentiary basis has been used to maintain the rejection and the rebuttal evidence outweighs any *prima facie* case of obviousness set forth in the Official Action, it is submitted that Claim 21 is patentable over the combination of Takao and Shigeru.

L. Rejection of Claims 22-23 under 35 U.S.C. §103(a) over JP 01-204424 (Takao)

Claims 22-23 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao. The Official Action contends that:

1. The Rejection

> Takao teaches a parallel plate electrode reactor to hold semiconductor wafers (page 2). Because Takao teaches substantially the same machine as applicants to perform plasma etching (page 2 and applicant's abstract), the claimed ranges would have been obvious in order to obtain a high precision etching apparatus (page 2 of Takao). That is, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process optimization, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980) (Final Office Rejection at ¶ bridging pages 7-8).

2. Claimed Subject Matter

Claim 22 depends from Claim 18 and recites that the disk has a diameter in the range from about 12 to 32 cm and a thickness in the range from about 0.1 to 2 cm. Claim 23 depends from Claim 18 and recites that the ring has an annular width in the range from about 0.5 to 5 cm and a thickness in the range from about 0.2 to 3 cm. As explained above, Takao fails to disclose a support ring as recited in Claim 18. as such, Takao there is no basis for the Examiner's allegation that "the claimed ranges would have been obvious." Clearly, as there is no support ring in Takao, Takao fails to disclose the claimed electrode assembly comprising an electrode disk and support ring bonded to the periphery of the disk, as recited in Claim 18 or such bonded assembly having the dimensions set forth in Claims 22 and 23. To the extent the Official Action contends that the water cooled electrode 4 of Takao corresponds to the claimed support ring, there is no basis for converting such water cooled electrode into a ring having a thickness of 0.2 to 3 cm as recited in Claim 23.

Takao does not disclose the claimed range of electrode disk diameter and thickness or support ring diameter and thickness. The rejection acknowledges that Takao fails to disclose any disk diameter or thickness or any ring diameter and thickness. Absent some teaching in the prior art, it is improper to reject the claimed features as "obvious ...to choose" (Official Action at page 7) As Takao fails to disclose a support ring or suggest the claimed dimensions, the rejection of Claims 22-23 is improper and should be reversed.

3. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claims 22 and 23.

M. Rejection of Claims 24-27 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) in view of JP 61-279672 (Yamada)

Claims 24-27 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Yamada. The Official Action contends that:

1. The Rejection

> Yamada teaches the plate is bonded to the support frame by means of a bonding layer, which has a low vapor pressure, bonding layer is formed by soldering (page 3, ll. 4-7). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the process of Takao to utilize bonding the support frame using indium in order to affix the target to the base (see Yamada page 3, ll. 1-20) (Final Rejection at page 8, ¶ 1).

2. Claimed Subject Matter

Claim 24 depends from Claim 18 and recites that the electrode disk is bonded to the support ring by a bonding layer, Claim 25 depends from Claim 24 and recites that the bonding layer is composed of a ductile metal or alloy or a metal-filled epoxy having a low vapor pressure, Claim 26 depends from Claim 25 and recites that the ductile metal or alloy is selected from indium, silver and metal filled epoxies, and Claim 27 depends from Claim 26 and recites that the bonding layer is formed by brazing, soldering or adhesion. The rejection does not identify where in the prior art the Examiner finds a teaching of bonding an electrode disk to a "support ring."

Instead, the Official Action cites Yamada for a teaching of a "support frame." As the Examiner cites Yamada for teachings related to a "support frame", and as explained above, Takao fails to disclose a support ring bonded to an electrode, there can be no suggestion in the combination of Takao and Yamada of (1) a bond between such support ring and the electrode or (2) an exposed face substantially free from protuberances as Takao only provides an electrode 7 clamped to water cooled electrode 4 by ring 12 and ring 12 is required in Takao to control the size of the plasma.

3. Improper Hindsight Reconstruction of Prior Art

The rejection over Takao in view of Yamada requires reliance on isolated teachings in Yamada without considering the overall context within which those teachings are presented. This rejection illustrates that without the benefit of Appellants' disclosure, a person of ordinary skill in the art would not know what portions of the disclosure of Yamada to consider. Such hindsight reconstruction of the prior art is improper and renders the rejection untenable. *In re Mercier*, *supra*.

4. Lack of Motivation, Lack of Reasonable Expectation of Success and Missing Claim Features

The rejection over Takao in view of Yamada fails to meet the three basic criteria set forth in *Vaeck*, *supra*. First, neither Takao nor Yamada teaches an electrode bonded to a support ring since Takao only discloses an etching apparatus including an amorphous carbon electrode 7 clamped to the annular bottom of aluminum electrode 4 by ring 12 and Yamada only discloses a sputtering apparatus located below a substrate holder 30 holding a plurality of substrates 28 on which a film is formed by sputtering a target 34 made of material for the film to be formed on

the substrates. The Official Action fails to establish the requisite motivation to incorporate isolated teachings in Yamada related to the sputtering in the etching apparatus of Takao. Further, Takao uses the ring 12 of insulating material to control the size of the plasma created by electrode 7 to be the size of the wafer 13 to be etched. To the extent the Official Action proposes to replace the ring 12 of Takao with a bond between electrode 7 and electrode 4, doing so would go against the teachings of Takao. Second, because the Official Action fails to provide any showing that amorphous carbon had been used as a sputtering material or that amorphous carbon is capable of being soldered to aluminum, the Official Action fails to establish the required reasonable expectation of success in soldering Takao's amorphous carbon electrode 7 to aluminum electrode 4. Third, even if Takao and Yamada were combined as proposed in the Official Action, there is no support ring and because ring 12 is required to control the size of the plasma the resulting combination of Yamada and Takao lacks (1) a bond between such support ring and the electrode and (2) the exposed face of the electrode substantially free from protuberances.

5. <u>Yamada Solves a Sputtering Problem Not Present in Takao</u>

Yamada discloses an improved cooling system for cooling a target of a sputtering apparatus (Yamada at page 1, lines 27-29). Yamada discloses that in a conventional sputtering apparatus, the target was indirectly cooled because the target was attached to a packing plate and the packing plate was cooled (Yamada at page 2, lines 5-12). Yamada's apparatus cools the target directly by using cooling fluid which contacts the opposite side of the sputtering surface (Yamada at page 2, lines 14-16). Thus, Yamada provides various embodiments to achieve such direct

cooling. In contrast, Takao explicitly states that the water cooled electrode 4 provides adequate cooling to the electrode 7 (see page 8, lines 2-8 of Takao). Thus, Takao does not share the cooling problem addressed in Yamada there would be no reason to look to Yamada for a solution to a problem which does not exist in Takao.

Yamada does not cool the target material at the edges of the target but rather supports the target at its edges to allow direct cooling of the target with water. To achieve this direct cooling, the target 34 can be soldered to projection 38 of fixing member 36 (Yamada at page 3, lines 2-7, Figures 2-3), the target 34 can be soldered to annular fixing member 86 (Yamada at page 4, lines 7-23, Figure 4), the target 34 can be attached to annular protrusion 88 with bolts (Yamada at page 4, lines 24-28, Figure 5) or the target 34 can be fixed on a packing plate 94 having concentric grooves 96 which allow cooling water to contact the target (Yamada at page 4, lines 29-32). In each case, the target is arranged to allow cooling fluid to contact the unexposed side of the target and it is essential that a solder or O-ring seal be formed to prevent leakage of the cooling fluid. Such water cooling would render Takao's electrode inoperable and only hindsight would lead a person of ordinary skill in the art to selectively remove the teaching of soldering in Yamada and apply it to Takao. Although the Official Action fails to establish a reasonable expectation of success in soldering Takao's amorphous carbon electrode to the water cooled aluminum electrode 4, even if such could be done the result would not provide (1) an electrode soldered to a support ring and (2) an exposed face of the electrode substantially free from protuberances as there is no structure in Takao corresponding to the claimed support ring and the ring 12 of Takao is required to control the size of the plasma.

Although a hindsight reconstruction of Takao would fail to produce the claimed subject matter, insufficient motivation has been relied on in support of the rejection. In Takao, the electrode 7 is used to supply etching gas to etch a semiconductor wafer and cooling of the amorphous carbon electrode 7 is achieved through the water cooled aluminum electrode 4. Such an arrangement is completely different from Yamada which relates to sputtering apparatus to deposit films on substrates and eliminates the conventional backing plate (such as in Shigeru) to achieve more efficient cooling of a target material intended to be sputtered. In view of the fact that the sputtering apparatus of Yamada functions in a completely different way than the etching apparatus of Takao, it is submitted that the Official Action fails to advance the required particular findings as to why a person of ordinary skill in the art, with no knowledge of the claimed invention, would have selected components from Yamada and combined them with Takao in the manner alleged in the Official Action.

6. No Substantial Evidence of Motivation to Combine

In the Official Action, Yamada is cited for disclosure of bonding a plate to a support frame with a bonding layer and it is alleged that it would have been obvious to modify Takao "to utilize bonding the support frame using indium in order to affix the target to the base" (Final Official Action at page 8). However, neither Takao nor Yamada discloses an electrode bonded to a support ring and the Examiner has not identified any teaching in the etch apparatus art of bonding an electrode disk to a support ring. Appellants were the first to propose bonding an electrode disk to support ring to obtain the benefits discussed above, i.e., the '456 patent provides an improved upper electrode assembly which (1) has desirable electrical and thermal

properties, (2) is compatible with many different plasma chemistries and (3) is relatively easy and inexpensive to fabricate and overcomes problems such as cracking of electrodes due to excess clamping pressures or particles produced by differentially expanded surfaces clamped together. Takao and Yamada fail to suggest the claimed invention and the claimed invention provides substantial improvements thereby rebutting any *prima facie* obviousness based on these references.

Yamada provides various arrangements to allow direct cooling of the target and while one arrangement includes a target soldered to a projection 38, there is no disclosure in Yamada of soldering an electrode disk to a support ring. Moreover, the purpose of Yamada's solder joint is to (1) allow cooling fluid from pipe 48 facing the lower surface of target 34 to fill space 54 and the target and (2) prevent the cooling water from leaking into the sputtering chamber. Thus, the target of Yamada is not analogous to the showerhead electrode of Takao since (1) the target of Yamada is used to deposit films whereas Takao uses the showerhead electrode to etch substrates and (2) Yamada's target must be free of gas passages to avoid the cooling water from leaking into the sputtering chamber, whereas Takao's showerhead electrode must include holes 10 to distribute etch gas in the chamber. Further, Takao achieves cooling of electrode 7 via contact with electrode 4 whereas Yamada flows cooling water against the target 34. Given the different uses and constructions of the Takao showerhead electrode and the Yamada sputtering target, the Examiner has not provided a proper legal basis for the obviousness rejection as particular findings are lacking as to why a person of ordinary skill in the art would have selected the isolated teaching of a soldered arrangement of Yamada and

substituted it for the clamped arrangement of Takao. The rejection is instead based on an impermissible obvious to try or hindsight reconstruction of the prior art and should be reversed.

The Examiner has failed to establish that it would have been obvious to those of ordinary skill in the art at the time of the invention to provide an electrode disk bonded to a support ring by means of a bonding layer. The only source of a suggestion to use the particular bonding layer to bond the electrode plate to the support ring claimed in the '456 patent is Appellants' own disclosure of the invention. In other words, the Examiner has relied on impermissible hindsight in making his determination of obviousness. *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992) (impermissible to engage in hindsight reconstruction of the claimed invention, using applicant's structure as a template and selecting elements from references to fill the gaps).

Yamada relates to improvements in sputtering and does not address Applicants' problem of differential expansion due to differences in the coefficients of thermal expansion between an electrode such as a showerhead electrode and support member. As such, the prior art fails to recognize the problem Appellants' invention overcame. In determining the differences between the prior art and the claims, the question under 35 U.S.C. §103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed. Cir. 1983). Thus, discovering the source or cause of a problem is part of the "as a whole inquiry." MPEP §2141.02 III. "[A] patentable invention may lie in the discovery of the

source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103." *In re Sponnoble*, 405 F.2d 578, 585, 160 USPQ 237, 243 (CCPA 1969).

Like Shigeru, Yamada relates to a sputtering target which is not used to flow reaction gas into a chamber and thus is not analogous to the showerhead electrode of Takao. Yamada's sputtering apparatus is used to sputter a substance constituting the target and adhere the substance onto surfaces of substrates by colliding a high-energy ion against a sputtering surface of a target consisting of the same substance to be adhered to the substrates (Yamada, page 1, line 32 to page 2, line 2 of translation). That is, the sputter target is a consumable source of material to build up a layer on the substrates. By contrast, the etching apparatus of Takao uses a plasma of reaction gas supplied by a showerhead electrode to etch a substrate (Takao, page 3, lines 16-21 of translation). As stated in *In re Hedges*, 783 F.2d 1038, 1039, 228 USPQ 685, 686 (Fed. Cir. 1986); quoting from *In re Wesslau*, 353 F.2d 238, 241, 147 USPQ 391, 393 (CCPA 1965): "It is impermissible within the framework of section 103 to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art." The Examiner has ignored at least the teaching of Yamada that requires a cooling fluid in direct contact with the back of the target, that is, a conventional sputtering apparatus was not able to achieve the improvements disclosed by Yamada because a target was indirectly cooled and the Examiner has ignored the

requirement that there be no apertures in the target. By ignoring these teachings in Yamada, the Examiner attempts to pick and choose other portions of Yamada to incorporate in Takao. However, such picking and choosing is an improper basis for an obviousness rejection.

As mentioned above, in one arrangement the Yamada target 34 (which is consumed and deposited as a film on substrates 28) is bonded at the periphery rather than completely across a backing plate to provide a water seal and reduce diffusion of solder into the target compared to a target bonded entirely across its surface (see page 3, lines 19-33 of Yamada translation). To the extent that Yamada reduced diffusion of solder in sputter targets, such is irrelevant with respect to Takao's etching apparatus.

There was no problem of solder diffusion into showerhead electrodes at the time of Appellants' invention since Appellants were the first to invent such a novel bonded electrode arrangement. Given the different structures and functions of Yamada's sputtering target (sputter films and prevent diffusion of solder into the target) compared to Takao's clamped showerhead electrode in an etching apparatus, it is submitted that the Examiner has failed to establish that persons of ordinary skill in the art at the time of invention would have been led by the teachings of Yamada to bond the electrode 7 to the ring 4 of Takao or use solder to do so for the purposes of the bond in Yamada, i.e., reducing diffusion of solder into the target. The only source of a suggestion to use a bond such as a solder joint to attach a showerhead electrode to a support member is the disclosure in the '456 patent. Therefore, the Examiner has relied on impermissible hindsight in making a determination of obviousness. *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780,

1784 (Fed. Cir. 1992) ("It is impermissible to engage in hindsight reconstruction of the claimed invention, using the applicant's structure as a template and selecting elements from references to fill the gaps"). Therefore, the rejection should be reversed.

In addition to the above, the Examiner has failed to identify where in the prior art one of ordinary skill would have found a disclosure or suggestion which would have led him to make the proposed modification. See *In re Kotzab*, 27 F.3d 1365, at 1371, 55 USPQ2d 1313, at 1317 (Fed. Cir. 2000) wherein the court stated that particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected the components for combination in the manner claimed. The absence of such particular findings in support of the rejection of Claims 24-27 renders the rejection improper.

7. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claims 24-27.

N. Rejection of Claim 28 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) and JP 61-279672 (Yamada) in view of JP 61-243170 (Shigeru)

Claim 28 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and Yamada and further in view of Shigeru. The reasons for the rejection are set forth on page 8 of the Official Action. The Official Action contends that:

1. The Rejection

> Shigeru teaches wherein at least one of the plate and the support frame is metallized (page 2, ll. 14-20). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Takao and Yamada to utilize metallizing one of the plate and the support frame in order to form a strong bond between the indium and the substrate (see Shigeru page 2). (Final Rejection, page 8, ¶ 2).

2. Claimed Subject Matter

Claim 28 depends from Claim 27 (which depends from interdependent Claims 26, 25, 24, 23 and 18) and recites that at least one of the disk and the support ring is metallized in the region to be bonded prior to brazing, soldering or adhesion. Claim 28 is patentable over the combination of Takao, Yamada and Shigeru for at least the reasons discussed above in connection with Claims 18 and 24-27. As explained above, Takao and Yamada fail to disclose or suggest an electrode disk bonded to a support ring and Shigeru (which teaches bonding a plate to a target material) also fails to cure the deficiencies of Takao and Yamada. As such, the addition of Shigeru cannot possibly suggest the combination of features recited in Claim 28. Further, as the ring 12 of Takao is essential to control the size of the plasma, even if Takao is reconstructed as proposed in the Official Action, the electrode 7 would not be substantially free from protuberances. Thus, the applied references cannot suggest all of the claimed features which includes (1) a support ring bonded to an electrode disk and (2) the exposed face of the electrode substantially free from protuberances.

3. Lack of Motivation to Combine Shigeru and Yamada With Takao

In the Official Action, Shigeru is cited for disclosure of metallizing the plate or support frame and it is alleged that it would have been obvious to modify Takao to utilize metallizing the plate or support frame "in order to form a strong bond between

the indium and the substrate" (Final Official Action at page 6, ¶ 1 and page 8, ¶ 2). However, as explained above, the Official Action fails to cite any prior art teaching a support ring bonded to an electrode disk.

Takao does not recognize the problem solved by the inventors of the '456 patent. "[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103." *In re Sponnoble*, 405 F.2d 578, 585, 160 USPQ 237, 243 (CCPA 1969). In the '456 patent, the inventors recognized the problem of manufacturing an electrode to meet requirements of compatibility with the plasma chemistries, while being relatively inexpensive, easy to fabricate, and purifiable to semiconductor purity (col. 2, lines 8-18 of the '456 patent). The plate portion of the composite electrode which is exposed to plasma can be formed from material which is most suitable for the processing conditions with less concern for the cost of the material or the ability to machine the material. Thus, the material of choice can be dictated primarily by plasma chemistry and the desirability to minimize formation of particles and release of other contaminates. Similarly, the support frame can be composed of a material which has desired electrical, thermal, and structural properties and which can be relatively easily machined or otherwise formed into a desired geometry, e.g. a ring. (Column 2, lines 52-66).

As explained above, Yamada and Shigeru relate to sputtering apparatus wherein the bonded target is free of gas apertures, an arrangement contrary to Takao's showerhead electrode. Sputtering targets are used to deposit films on

substrates whereas Takao relates to etching patterns into films (see page 2, lines 1-6 of translation of Takao). As neither Shigeru nor Takao relates to plasma etching or electrodes of plasma etching apparatus, it is submitted that a person of ordinary skill in the art would not have been led by the teachings of Shigeru or Yamada to modify Takao in the manner proposed in the Official Action. In addition, the Examiner has not adequately explained how Shigeru and Yamada could be combined with Takao. For example, as explained above, Yamada supplies cooling water to contact the back of the sputtering target, whereas Takao discloses an electrode with apertures for supplying the plasma gas which would leak cooling water into the plasma chamber. Likewise, Shigeru discloses a cooling plate contacting the entire back surface of the sputtering target, to prevent the target material from instantly burning out (Shigeru, page 2, lines 7-8 of translation). Applying the teachings of Shigeru and Yamada to Takao as proposed in the final rejection requires impermissible picking and choosing isolated disclosures of the secondary references with the only motivation coming from Appellants' disclosure. Such hindsight reconstruction of the prior art is improper.

An adequate showing of motivation to combine requires evidence that a person of ordinary skill in the art would, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. *Ecolochem Inc. v Southern Calif. Edison Co.*, 227 F.3d 1361, 1375, 56 USPQ2d 1065, 1075 (Fed. Cir. 2000) quoting *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1456 (Fed. Cir. 1998). In the present case, the Examiner has not shown that one of ordinary skill would have found proper motivation to select the features from

Yamada and Shigeru related to bonding and combined them with Takao absent knowledge of the claimed invention. Because the only reason or suggestion to modify the teachings of Takao comes from Appellants' disclosure, the rejection is improper and should be reversed. However, even if Takao was modified as proposed in the Official Action, the resulting combination fails to produce a support ring bonded to an electrode disk. As such, the rejection is untenable and should be reversed.

4. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claim 28.

O. Rejection of Claim 29 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) and JP 61-279672 (Yamada) and further in view of JP 61-243170 (Shigeru)

Claim 29 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and Yamada and further in view of Shigeru. The Official Action contends that:

1. The Rejection

> Shigeru teaches the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding (p. 2, ll. 19-20 and figure 3, item 102). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Takao and Yamada to utilize the bonding layer is free from voids and uniform electrical and thermal conductivities in order to form a strong bond to the substrate (see Shigeru page 2). (Final Rejection at ¶ bridging pages 8-9).

2. Claimed Subject Matter

Claim 29 depends from Claim 24 (which depends from Claim 18) and sets forth that the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding. Claim 29 is patentable over the combination of Takao, Yamada and Shigeru for at least the reasons discussed above in connection with Claim 18. As explained above, Takao and Yamada fail to disclose or suggest an electrode disk bonded to a support ring and Shigeru (which teaches bonding a plate to a target material) also fails to cure the deficiencies of Takao and Yamada. As such, the addition of Shigeru cannot possibly suggest the combination of features recited in Claim 29. Further, as the ring 12 of Takao is essential to control the size of the plasma, even if Takao is reconstructed as proposed in the Official Action, the electrode 7 would not be substantially free from protuberances. Thus, the applied references cannot suggest all of the claimed features which includes (1) a support ring bonded to an electrode disk and (2) the exposed face of the electrode substantially free from protuberances.

3. Lack of Motivation to Combine Shigeru and Yamada With Takao

As mentioned above, rejections under 35 U.S.C. §103 must be based on "evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness" *In re Lee*, 277 F3d 1338, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002). A showing of a suggestion, teaching, or motivation to combine the prior art references is an essential component of an obviousness holding and "particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner

claimed." (Emphasis Added). *Id.* Conclusory statements regarding what is "basic knowledge" and "common sense" cannot be used to cure deficiencies of the cited references.

In the rejection, it is stated that page 2, lines 19-20 of Shigeru "teaches the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding" (Official Action at pages 8-9). However, such language is not found in Shigeru. Instead, the quoted language is taken from Appellants' Claim 29. The quoted portion of Shigeru in the Official Action actually states that bonding is "carried out in a vacuum chamber to prevent voids" (Shigeru at page 2, lines 19-20). In Shigeru, a bonding layer of indium is applied to a silicon dioxide plate, a non-electrically conductive material. As such target material is non-electrically conductive, there is no basis for the Examiner's allegation that Shigeru "teaches" that the bonding layer provides "uniform electrical" conductivity. Thus, the Official Action errs in citing Shigeru for a teaching of using a bonding layer to achieve uniform electrical conductivity.

The Official Action also cites Shigeru for a teaching of using a bonding layer to obtain uniform thermal conductivity. However, Shigeru seeks to prevent temperature elevation of the metallic oxide target material and stability of sputtering film formation (see page 3, lines 24-27 of Shigeru). Other than impermissible hindsight, there would be no reason to consider Shigeru's teachings of using a bonding layer to obtain stability of sputtering film formation as motivation for bonding the amorphous carbon electrode 7 of Takao to the water cooled aluminum electrode 4. And, as explained above, Shigeru does not teach use of the bonding layer to obtain uniform electrical conductivity to the non-electrically conductive silicon dioxide

target material. Accordingly, the Official Action fails to advance adequate motivation for modifying Takao to have a bonding layer between the amorphous carbon electrode 7 and the water cooled aluminum electrode 4. However, even if Takao was modified as proposed in the Official Action, the resulting combination fails to produce a support ring bonded to an electrode disk.

Yamada and Shigeru relate to sputtering apparatus and thus the structures and function of the sputtering targets are nonanalogous to the showerhead electrode of Takao. Sputtering targets are used to deposit films on substrates whereas Takao relates to etching patterns into films (see page 2, lines 1-6 of translation of Takao). As Shigeru does not relate to showerhead electrodes of plasma etching apparatus, it is submitted that a person of ordinary skill in the art would not have been led by the teachings of Shigeru to modify Takao in the manner proposed in the Official Action. In addition, the Examiner has not adequately explained how Shigeru and Yamada could be combined with Takao. For example, as explained above, Yamada supplies cooling water to contact the back of the sputtering target, whereas Takao discloses an electrode with apertures for supplying the plasma gas which would leak cooling water into the plasma chamber rendering the prior art unsatisfactory. Likewise, Shigeru discloses a cooling plate contacting the entire back surface of the sputtering target, otherwise the target material can instantly burn out (Shigeru, page 2, lines 7-8 of translation). Modifying Takao to incorporate the aperture free backing plate of Shigeru leads to an inoperative arrangement. Modifying Takao to incorporate an aperture free target of Yamada also leads to an inoperative arrangement. If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to

make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

It is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983). Here, Shigeru discloses a backing plate to cool a sputtering target bonded to the backing plate (see, for example, Figures 1-3 and page 2, lines 7-11 of translation), whereas Yamada, discloses that a conventional sputtering apparatus was not able to achieve the improvements disclosed by Yamada because a target was indirectly cooled by attaching a target on a backing plate and cooling the backing plate. (Yamada translation at page 2, lines 10-12) Yamada solders an aperture free target 34 to the fixing member 36 to allow water cooling of the backside of the target. (Yamada translation at page 4, lines 29-32). Because the Examiner's selective combination of Shigeru and Yamada is clearly based on improper hindsight, the rejection is improper and should be reversed.

4. Lack of Reasonable Expectation of Success

The Official Action fails to allege a reasonable expectation of success in bonding Takao's amorphous carbon electrode 7 to the bottom of aluminum electrode 4 as the Official Action does not explain how amorphous carbon could be bonded to aluminum. Shigeru discloses an arrangement wherein the entire face of the target material is covered by an aperture free plate. As explained in connection with the rejection of Claim 7, it would not have been obvious to follow the teachings of Shigeru (wherein a cup-shaped plate covers the target material) since covering the electrode disk of Takao for Shigeru's purposes of lowering temperature elevation during bonding would cover the gas passages in Takao's electrode and render it

inoperative. As for the needed showing of a reasonable expectation of success, it is submitted that Shigeru does not teach how to bond amorphous carbon to aluminum and the result of covering Takao's gas holes in electrode 7 would not lead to a reasonable expectation of success of fabricating an operable showerhead electrode.

5. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claim 29.

P. Rejection of Claim 32 under 35 U.S.C. §103(a) over JP 01-204424 (Takao) in view of JP 61-243170 (Shigeru)

Claim 32 stands rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Takao and further in view of Shigeru. The Official Action contends that:

1. The Rejection

> Shigeru teaches a backing plate is bonded around the periphery of the silicon oxide plate. The material of the backing plate Cu has a higher CTE (coefficient of thermal expansion) than the electrode plate. When cooled, the differential contraction imparts the stress. The Examiner maintains that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the apparatus of Takao to utilize the particular structure of the backing plate and electrode plate in order to obtain uniform film formation (see Shigeru page 2). (Final Rejection at page 9, ¶ 1).

2. Claimed Subject Matter

Claim 32 recites that the support ring is pre-stressed to impart radially inward compression on the electrode disk. In the Official Action, Figure 1 of Shigeru is cited

for disclosure of a backing plate bonded around the periphery of a silicon oxide plate wherein the backing plate is copper (Cu) having a higher coefficient of thermal expansion (CTE) than the electrode plate (Final Rejection at page 9, ¶ 1). It is alleged that it would have been obvious to modify Takao to utilize the backing plate and electrode plate of Shigeru "to obtain uniform film formation" (Final Rejection at page 9). However, neither Takao nor Shigeru disclose a support ring bonded to an electrode disk. As such, the combination of Shigeru cannot possibly produce the combination of features recited in Claim 32.

3. Missing Claim Features

The Official Action also does not explain (1) why it would have been obvious to replace the water cooled electrode 4 of Takao with a support ring, (2) why a person of ordinary skill would desire "uniform film formation" using the Takao etching apparatus wherein the object is to etch a substrate rather than deposit a film on a substrate, (3) how a bond which is missing in Takao can be pre-stressed, (4) how the amorphous carbon electrode 7 of Takao could be bonded to a support ring, and (5) how Shigeru (which relates to a sputtering target wherein a silicon dioxide plate 1 is fixed onto a heat radiating backing plate 3) wherein there is no support ring to be pre-stressed can suggest modifying Takao to have a pre-stressed support ring. As such, the combined references fail to suggest a support ring bonded to an electrode disk or a support ring pre-stressed to impart a radially inward compression on the electrode disk, as recited in Claim 32.

4. Lack of Evidentiary Basis for Rejection

Given the fact that Takao seeks to etch a substrate, the Examiner's alleged motivation based on obtaining uniform film formation is in error. Further, since Shigeru clearly fails to teach a pre-stressed support ring, the evidentiary basis for the rejection is missing. Accordingly, it is submitted that a person of ordinary skill in the art would not have been led by the teachings of Shigeru to modify Takao in the manner proposed in the Official Action but even if Takao was modified to include a bond between electrode 7 and electrode 4, the resulting combination fails to produce a support ring bonded to an electrode disk or a support ring which is pre-stressed. There is absolutely no teaching in the applied prior art of the claimed pre-stressed support ring. As such, the rejection is untenable and should be reversed.

Shigeru discloses a bonding method to fix a heat radiating backing plate to a sputtering target with indium by first cleaning the sputtering target surface with fuming nitric acid before lapping the target to the backing plate under atmospheric conditions. (Shigeru translation title, abstract, and page 3 lines 2-5, 16-18). Adhering and fixing of the silicon dioxide plate (1) onto the plate (3) can be carried out in the atmosphere without a vacuum chamber, which had been used in the conventional art. According to Shigeru, the silicon dioxide plate (1) and the plate (3) are sufficiently cooled by the water flowing through a cooling water path (5) and the heat radiation into the atmosphere, preventing the temperature elevation of the plate (1) and resulting in the stability of the sputtering film formation. (Shigeru translation at page 3 lines 14-20). Thus, because Shigeru states that temperature elevation of the plate is prevented, there is no basis for the Examiner's contention that the cooled copper would expand and provide differential contraction or that differential contraction is desirable. The fact that a certain result or characteristic may occur or

be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993). That is, inherency may not be established by probabilities or possibilities. *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999). See also MPEP §2112 wherein it is stated that the Examiner must provide a basis in fact and/or technical reasoning to reasonably support a determination that allegedly inherent characteristics flows from the teachings of the applied prior art. Nowhere in Shigeru or in Takao is the desirability of a radially inward compression on an electrode disk mentioned. Absent some objective teaching in the prior art of the claimed feature, it is submitted that the rejection is untenable and should be reversed.

Neither Takao nor Shigeru disclose a ring bonded to an electrode in a manner which results in radially inward compression on the electrode. Shigeru does not bond a ring to the target and other than the Examiner's unsupported conclusory arguments there is no evidentiary support for the rejection.

In response to Appellants' argument that Shigeru fails to teach the claimed "pre-stress", the Examiner states that while the bonding process of Shigeru is carried out while circulating water inside the copper backing plate and the cooling water cools both plates (the target and backing plate), "it is the examiner's position that the cooling water creates a temperature gradient from the outer plate to the inner plate, which would cause the temperature to gradually decrease." The Examiner does not explain how the two plates of Shigeru which are simultaneously cooled imparts a pre-stress. Perhaps the Examiner's position is that if Takao's amorphous carbon showerhead electrode 4 is bonded to the lower surface of the aluminum electrode 7, the result would be a pre-stress and the aluminum electrode 7 would impart a

radially inward compression on the electrode disk 4. Such a position is based on speculation and Shigeru's teachings to bond a plate over the entire surface of a target material does not provide a teaching that an inward compression on the electrode 7 of Takao would be desirable. Speculation as to an alleged inherent result cannot be the basis of an obviousness rejection. See *In re Rijckaert*, 9 F3d 1531, 28 USPQ2d 1955 (Fed. Cir. 1993) and *In re Oelrich* (supra) 666 F2d 578, 212 USPQ 323 (CCPA 1981). In the present case, there is no evidentiary basis for the rejection. As such, the rejection of Claim 32 should be reversed.

Takao's showerhead electrode 7 is not bonded to the supporting electrode 4 and Shigeru relates to a nonanalogous sputtering target bonded to a backing plate. Neither reference discloses the desirability of imparting a radially inward compression on a showerhead electrode which can inhibit stress fracturing the electrode during use (see '456 patent at column 6, lines 62-67). To achieve the pre-stress the support ring has a larger thermal expansion than the electrode plate and the bond is cured or formed at a temperature above the operating temperature, the support ring will apply a constant compressive force on the electrode plate and bonding layer (column 7, lines 1-6 of '456 patent). Because neither Takao nor Shigeru disclose such a concept, the rejection of Claim 32 is in error and should be reversed.

5. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claim 32.

Q. Rejection of Claims 33-36 under 35 U.S.C. §103(a) over JP 61-243170 (Shigeru) and JP 61-279672 (Yamada)

Claims 33-36 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Shigeru and Yamada. The Official Action contends that:

1. The Rejection

> Shigeru teaches bonding the backing plate to an electrode plate (silicon dioxide) at elevated temperature (170 C, translation page 2), wherein the material of the electrode plate (Cu) has a higher coefficient of thermal expansion that that of the electrode plate (silicon dioxide); and allowing the bonded assembly to return to room temperature, whereby the differential contractions imparts the desired stress (page 2); Yamada teaches a forming an electrode assembly including a support ring and an electrode plate (figure 3, item 38); wherein the elevated temperature is chosen to be above an expected operating temperature of the electrode assembly (page 2); wherein the electrode plate is formed from a substantially pure material selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina, zirconium, diamond-coated materials, and titanium oxides (page 2). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the backing plate and electrode plate to utilize forming an electrode assembly having a support ring and electrode plate in order to provide a sputtering apparatus that enables a high purity film formation (see Yamada page 2). (Final Rejection, pages 9-10)

2. Claimed Subject Matter

Claim 33 was amended via Preliminary Amendment to correct an obvious error set forth in line 6 (electrode plate should be supporting ring) and sets forth a method of forming an electrode assembly including a support ring and an electrode plate, the method comprising bonding the support ring about the periphery of the electrode plate at an elevated temperature, wherein the material of the supporting ring has a higher coefficient of thermal expansion than that of the electrode plate, and allowing the bonded assembly to return to room temperature, whereby the differential contraction imparts the desired stress. Claims 34-36 depend from Claim

33. As explained above in connection with Claims 5, 8, 9 and 18-32, neither Shigeru nor Yamada disclose a support ring bonded to an electrode plate and as explained in connection with the rejection of Claim 32, Shigeru's teachings to bond a plate over the entire surface of a target material does not provide a teaching that an inward compression on the electrode 7 of Takao would be desirable. Yamada is likewise deficient in this regard. Accordingly, the combination of Shigeru and Yamada cannot possibly suggest the method recited in Claim 33.

3. **Missing Claim Features**

As explained at column 6, line 62 through column 7, line 12 of Applicants' U.S. Patent No. 5,074,456, support ring 14 can be formed of a material which has a slightly larger thermal expansion coefficient than that of the electrode plate to "pre-stress" the support ring to provide radially-inward compression on the electrode plate and bonding layer:

> In forming the electrode assembly 10, it will be desirable to "pre-stress" the support ring 14 so that it provides a radially-directed inward compression on the electrode plate 12. Such a compressive stress helps to inhibit stress fracturing of the electrode plate 12 during use. More specifically, by utilizing a support ring 14 which is formed from a material which has a slightly larger thermal expansion coefficient than that of the electrode plate, and forming or curing the bonding layer at a temperature above the expected operating temperature, the support ring will apply a constant compressive force on both the electrode plate and the bonding layer. Even when the temperature of the electrode assembly is raised from room temperature to the operation temperature, the support ring will still be in compression (although reduced relative to room temperature). Thus, thermal cycling will be less likely to fracture the electrode plate which is fragile relative to the support ring.

In the Official Action, Shigeru is cited for disclosure of differential contraction allegedly imparting the "desired stress" (sentence bridging pages 9-10 of the Final Official Action). However, nowhere in Shigeru is the phrase "desired stress"

mentioned. The only source of this concept is from the Appellants' disclosure. Shigeru states that a cooling system circulates water inside copper backing plate 103 when silicon dioxide plate 101 (the target material) is bonded to the copper backing plate (see translation at page 2, lines 21-29 of Shigeru). Thus, there is no evidentiary basis to conclude that a pre-stress would be produced or desired in the Shigeru arrangement.

Yamada is cited for alleged disclosure of an electrode assembly including a support ring and electrode plate of substantially pure material and it is alleged in the Official Action that it would have been obvious to modify "the backing plate and electrode plate in order to provide a sputtering apparatus that enables a high purity film formation" (Official Action at pages 9-10). However, Yamada relates to a modification of the Shigeru arrangement wherein the backing plate of Shigeru is eliminated to allow direct cooling of the sputtering material with cooling water directed against the backside of the sputtering target material. As explained above in connection with the rejection of Claim 32, Shigeru fails to disclose bonding an electrode to a plate to achieve a desired stress due to differential contraction and only speculation would provide the basis for the Examiner's allegation that such pre-stress would be inherent in bonding an electrode plate to a support ring.

Like Shigeru, Yamada also fails to disclose or suggest the desirability of using a support ring having a higher coefficient of thermal expansion than an electrode plate and using differential contraction to achieve a desired stress. As such, the method recited in Claim 33 is clearly not suggested by the combination of Shigeru and Yamada.

4. <u>References Teach Away From Their Combination</u>

Furthermore, Yamada teaches away from combination with Shigeru since Yamada teaches that a conventional sputtering apparatus (as in Shigeru) was not able to achieve the improvements desired by Yamada because in the conventional sputtering apparatus a target was attached to a backing plate and the backing plate was cooled. (Yamada translation at page 2, lines 10-12). Yamada overcame the cooling problem by eliminating the backing plate so the backside of the target could be cooled with water. It is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983) (The claimed catalyst which contained both iron and an alkali metal was not suggested by the combination of a reference which taught the interchangeability of antimony and alkali metal with the same beneficial result, combined with a reference expressly excluding antimony from, and adding iron to, a catalyst.). Here, Shigeru teaches a backing plate to cool a sputtering target bonded to the back of the sputtering target (see, for example, Figures 1-3 and page 2, lines 7-11 of translation) whereas Yamada teaches that a conventional sputtering apparatus was not able to achieve the improvements disclosed by Yamada because a target was indirectly cooled by attaching a target on a backing plate and cooling the backing plate. (Yamada translation at page 2, lines 10-12) Yamada further teaches that, because the target 34 is soldered to the fixing member 36 only at the periphery, compared with those prior art sputtering targets soldered to the backing plate on the entire lower surface, there is less diffusion of the solder material into the target 34 resulting in less contamination to the target 34, which is generally made of a highly pure material, and also resulting in improved purity of the formed film. (Yamada translation at page 4, lines 29-32). Clearly, Shigeru and Yamada teach

away from their combination and the Examiner has improperly combined these references.

5. Improper Picking and Choosing

The Examiner has picked elements from the various prior art using impermissible hindsight and the claimed invention as a roadmap by not offering any evidence of a motivation to combine. *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1143, 227 USPQ 543, 551 (Fed. Cir. 1985). In the Official Action, there is no reason for the Examiner's proposed selective combination of Shigeru and Yamada. Accordingly, Claim 33 and the claims dependent thereon are clearly patentable over the combination of Shigeru and Yamada.

6. Rebuttal Evidence

Evidence rebutting any *prima facie* obviousness is set forth above in Sections C(3) and G(7). Such evidence is incorporated by reference in response to the rejection of Claims 33-36.

VIII. Claims Appendix

See attached Claims Appendix for a copy of the claims involved in this appeal.

IX. Evidence Appendix

There is no additional evidence relied on in this Appeal Brief as indicated in the attached Evidence Appendix.

X. Related Proceedings Appendix

There are no Related Proceedings for this appeal as indicated on the attached Related Proceedings Appendix.

XI. Conclusion

For the foregoing reasons, reversal of the rejections of Claims 1-36 is respectfully requested.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date August 30, 2007

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XII. Certificate of Service

It is certified that a copy of this communication (if filed by other than the patent owner) has been served in its entirety on each third party requester as provided in 37 CFR 1.33(c) - The names and addresses of the parties served and the date of service are:

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Table of Contents

VIII. CLAIMS APPENDIX

The Appealed Claims

1. (Previously Presented) An improved reactor of the type having a first electrode for supporting a substrate, an opposed electrode, and means for producing a plasma therebetween, wherein the opposed electrode has one face exposed to the first electrode and an opposite face connected to an electrical source and a thermal sink, the improvement comprising an opposed electrode including (a) an electrode plate composed of a substantially pure material and having a substantially uniform thickness and (b) a support frame composed of an electrically and thermally conductive material bonded to a back face of the plate, whereby the support frame is connected to the electrical source and thermal sink and a front face of the plate which is exposed to the first electrode is substantially free from protuberances.

2. (Previously Presented) An improved reactor as in claim 1, wherein the opposed electrode is mounted in an assembly having an insulating ring which is flush with the entire periphery of the exposed face, whereby the support frame is protected from exposure to the plasma.

3. (Previously Presented) An improved reactor as in claim 1, wherein the electrode plate comprises a disk.

4. (Previously Presented) An improved reactor as in claim 3, wherein the disk includes a plurality of apertures therethrough to permit the flow of a reactant gas into the space between the electrodes.

5. (Previously Presented) An improved reactor as in claim 3, wherein the support frame comprises a ring which is secured about the periphery of the disk.

6. (Previously Presented) An improved reactor as in claim 3, wherein the support frame comprises a plurality of concentric rings secured to the opposite face of the electrode disk.

7. (Previously Presented) An improved reactor as in claim 3, wherein the support frame comprises a flat plate which is secured to and covers substantially the entire opposite face of the electrode disk.

8. (Previously Presented) An improved parallel electrode reactor as in claim 5, wherein the disk as a diameter in the range from about 12 to 32 cm and a thickness in the range from about 0.1 to 2 cm.

9. (Previously Presented) An improved reactor as in claim 8, wherein the ring has an annular width in the range from about 0.5 to 5 cm and a thickness in the range from about 0.2 to 3 cm.

10. (Previously Presented) An improved reactor as in claim 1, wherein the plate is bonded to the support frame by means of a bonding layer.

11. (Previously Presented) An improved reactor as in claim 10, wherein the bonding layer is composed of a material having a low vapor pressure.

12. (Previously Presented) An improved reactor as in claim 11, wherein the bonding layer material is selected from the group consisting of indium, silver, and metal-filled epoxies.

13. (Previously Presented) An improved reactor as in claim 12, wherein the bonding layer is formed by brazing, soldering, or adhesion.

14. (Previously Presented) An improved reactor as in claim 13, wherein at least one of the plate and the support frame is metallized in the region to be bonded prior to brazing, soldering, or adhesion.

15. (Previously Presented) An improved reactor as in claim 10, wherein the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding.

16. (Previously Presented) An improved reactor as in claim 1, wherein the electrode plate is composed of a pure material selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina, zirconium, diamond-coated materials, and titanium oxides.

17. (Previously Presented) An improved reactor as in claim 1, wherein the electrically and thermally conductive material is selected from the group consisting of graphite, aluminum, copper, and stainless steel.

18. (Previously Presented) An electrode assembly comprising:

an electrode disk composed of a substantially pure material and having a substantially uniform thickness; and

a support ring bonded about the periphery of one face of the disk, leaving the other face substantially flat and free from protuberances, wherein the support ring is composed of an electrically and thermally conductive material.

19. (Previously Presented) An electrode assembly as in claim 18, wherein the disk includes a plurality of apertures to permit gas flow therethrough.

20. (Previously Presented) An electrode assembly as in claim 18, further comprising at least one additional support ring mounted concentrically within the peripheral support ring or the one face of the disk.

21. (Previously Presented) An electrode assembly as in claim 18, wherein the support ring includes an interior plate which contacts substantially the entire one face of the disk.

22. (Previously Presented) An electrode assembly as in claim 18, wherein the disk has a diameter in the range from about 12 to 32 cm and a thickness in the range from about 0.1 to 2 cm.

23. (Previously Presented) An electrode assembly as in claim 18, wherein the ring has an annular width in the range from about 0.5 to 5 cm and a thickness in the range from about 0.2 to 3 cm.

24. (Previously Presented) An electrode assembly as in claim 18, wherein the disk is bonded to the ring by means of a bonding layer.

25. (Previously Presented) An electrode assembly as in claim 24, wherein the bonding layer is composed of a ductile metal or alloy or a metal-filled epoxy having a low vapor pressure.

26. (Previously Presented) An electrode assembly as in claim 25, wherein the ductile metal or alloy is selected from the group consisting of indium, silver, and metal-filled epoxies.

27. (Previously Presented) An electrode assembly as in claim 26, wherein the bonding layer is formed by brazing, soldering, or adhesion.

28. (Previously Presented) An electrode assembly as in claim 27, wherein at least one of the disk and the ring is metallized in the region to be bonded prior to brazing, soldering, or adhesion.

29. (Previously Presented) An electrode assembly as in claim 24, wherein the bonding layer is substantially free from voids and has substantially uniform electrical and thermal conductivities through the region of bonding.

30. (Previously Presented) An electrode assembly as in claim 18, wherein the material is selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina, zirconium, diamond-coated materials, and titanium oxides.

31. (Previously Presented) An electrode assembly as in claim 18, wherein the electrically and thermally conductive material is selected from the group consisting of graphite, aluminum, copper, and stainless steel.

32. (Previously Presented) An electrode assembly as in claim 18, wherein the support ring is pre-stressed to impart a radially inward compression on the electrode disk.

33. (Previously Presented) A method for forming an electrode assembly including a support ring and an electrode plate, said method comprising:

bonding the support ring about the periphery of the electrode plate at elevated temperature, wherein the material of the support ring has a higher coefficient of thermal expansion than that of the electrode plate; and

allowing the bonded assembly to return to room temperature, whereby the differential contraction imparts the desired stress.

34. (Previously Presented) A method as in claim 33, wherein the elevated temperature is chosen to be above an expected operating temperature of the electrode assembly.

35. (Previously Presented) A method as in claim 33, wherein the electrode plate is formed from a substantially pure material selected from the group consisting of graphite, polycrystalline silicon, quartz, glassy carbon, single crystal silicon, pyrolytic graphite, silicon carbide, alumina, zirconium, diamond-coated materials, and titanium oxides.

36. (Previously Presented) An electrode assembly formed by the method of claim 33.

IX. EVIDENCE APPENDIX

None

X. RELATED PROCEEDINGS APPENDIX

There are no related proceedings for this appeal.